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**UNDERSTANDING TOTAL FACTOR  
PRODUCTIVITY GROWTH  
IN SUB SAHARAN AFRICA COUNTRIES**

**by**

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Joachim Nymeck BINAM  
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**CENTRE D'ETUDES ET DE RECHERCHES EN  
ECONOMIE ET EN GESTION  
(CEREG)**

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## AVANT-PROPOS

Le Secrétariat d'Appui Institutionnel à la Recherche Économique en Afrique (SISERA) a pour mission de faciliter l'émergence de centres d'excellence en recherche économique en Afrique subsaharienne et de les aider à jouer un rôle effectif dans le processus d'élaboration des politiques économiques. Un des objectifs du Secrétariat est d'aider les centres à disséminer les résultats de leurs travaux de recherche.

Les Cahiers du SISERA ont donc été créés pour permettre une meilleure diffusion des travaux de recherche des Institutions partenaires du Secrétariat. La présente édition des Cahiers du SISERA est consacrée à diffusion des résultats des études conduites par six Institutions partenaires du SISERA dans le cadre du programme de formation et de recherche en économie dénommé « Stratégies et analyses pour le développement et l'accès à la croissance (SAGA) » mis en place par l'USAID et administré par SISERA. L'objet de ce programme est d'accroître les capacités africaines à produire une recherche de haut niveau qui réponde aux préoccupations politiques, sur des aspects essentiels touchant le développement économique et l'accès à la croissance en Afrique subsaharienne.

Dans le cadre de ce programme, le SISERA a organisé une mise en compétition de projets de recherche, destinée à financer des propositions soumises par des centres africains de recherches économiques. Six propositions ont été financées et les études ont été conduites sur une période d'environ deux ans, de novembre 2003 en mars 2006. Les six Institutions partenaires dont les propositions ont été retenues sont, "African Institute of Applied Economics (AIAE)" du Nigeria, le Centre d'Études et de Recherche en Économie et en Gestion (CEREG) de l'université Yaoundé II au Cameroun, le Centre de Recherches Économiques Appliquées (CREA) de l'université Cheikh Anta Diop du Sénégal, le Centre Ivoirien de Recherche Économique et Social (CIRES) de l'université de Cocody en Côte d'Ivoire, "Development Policy Research Unit (DPRU) de l'université du Cape en Afrique du Sud, et le "Namibian Economic Policy Research Unit (NEPRU), Windhoek, Namibie. Les études ont été réalisées pendant la période novembre 2003 en mars 2006.

## FORWORD

The mission of the Secretariat for Institutional Support for Economic Research in Africa (SISERA) is to facilitate the emergence of centers of excellence in economic research in sub-Saharan Africa, and to help them play an effective role in the economic policymaking process. One of the objectives of the Secretariat is to help the centers disseminate the findings of their research works.

The SISERA Working Papers Series was designed to provide an outlet for the research output of the Secretariat's Partner Institutions. This edition of the Working Papers is devoted to the dissemination of the results of studies conducted within the framework of the training and research program "Strategies and Analyses for Growth and Access (SAGA)" set up and funded by USAID and administered by SISERA. The overall goal of SAGA is to increase African capacity to produce high quality, policy-oriented research on key issues affecting economic growth and access in sub-Saharan Africa.

In relation with this program, SISERA has organized a research competition program to support research projects carried out by African economic research institutes. Six propositions were selected for funding and the related studies were implemented over about two years from November 2003 to March 2006. The six successful research proposals were submitted by the African Institute of Applied Economics (AIAE) in Nigeria, "Centre d'Études et de Recherche en Économie et en Gestion (CEREG)", University of Yaoundé II, Cameroon, "Centre de Recherches Économiques Appliquées (CREA), Université Cheikh Anta Diop, Senegal, "Centre Ivoirien de Recherche Économique et Social (CIRES)", University of Cocody, Côte d'Ivoire, Development Policy Research Unit (DPRU), University of Cape Town, South Africa, and the Namibian Economic Policy Research Unit (NEPRU), Windhoek, Namibia.

## **Abstract**

The slow growth in Sub-Saharan Africa (SSA) States observed between the early 1970s and 1990s has stimulated the discussion about its determinants. This paper contributes to this discussion by assessing the factors behind differences in total factor productivity (TFP) across SSA countries over the period 1965-2000. The cross-section, fixed-effects using annual data, fixed-effects using data in 3-year averages as well as the seemingly unrelated regression (SUR) results show that (i) openness to world trade is conducive to TFP in SSA region only if issues related to supply conditions such as poor transport and communication infrastructure, erratic supply of electric energy, corruption and bad governance, insufficient education of the labour force, etc. are adequately addressed, (ii) physical capital accumulation is important for TFP, (iii) the size of the financial sector matters for TFP, and (iv) population growth is conducive for TFP in some SSA countries and negative for TFP in other SSA countries.

## **Résumé**

La faible croissance économique observée dans les pays d'Afrique Subsaharienne (ASS) entre le début des années 1970 et la décennie 1990 a stimulé la discussion concernant les déterminants de cette croissance économique. En évaluant les facteurs qui expliquent les différences de productivité globale des facteurs (PGF) entre les pays d'ASS au cours de la période 1965-2000, ce papier constitue une contribution à cette discussion. Les résultats des estimations en section croisée, des effets fixes avec des données annuelles, des effets fixes avec des données en moyenne de 3 ans, ainsi que de la régression apparemment non reliée montrent que (i) l'ouverture au commerce mondial est propice à la PGF en ASS si et seulement si les problèmes liés aux conditions d'offre tels que la faible qualité des infrastructures de transport et de télécommunication, l'offre erratique de l'énergie électrique, la corruption et la mauvaise gouvernance, l'insuffisante éducation de la force de travail ; etc. sont résolus de façon adéquate ; (ii) l'accumulation du capital physique est importante pour la PGF ; (iii) la taille du secteur financier constitue un problème pour la PGF; et (iv) la croissance de la population est propice pour la PGF dans certains pays d'ASS et possède un effet négatif sur la PGF dans d'autres pays d'ASS.

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# 1. Introduction

In comparison with countries in other regions of the developing world, it is generally agreed that Sub-Saharan Africa (SSA) countries under-performed over the last three decades. A major policy concern is then how to reverse this undesirable growth trend. The economic literature points to a diverse set of potential causes of SSA's poor economic performance, ranging from external shocks to domestic policies. During the 1980s, the exchange rate and trade policies were identified as the primary causes of slow growth in SSA-exchange rate overvaluation and tight trade restrictions were damaging.<sup>2</sup> Also, the growth slowdown was due to deteriorating and volatile terms of trade. During the last decade, these policies which reduced SSA openness to world trade have largely been reversed. However, SSA closed the century with a mixed record. Therefore, domestic policies may now be the main obstacles to growth in SSA. Domestic factors, which appear to have been important in explaining growth performance, are related to poor education, political instability, lack of economic infrastructure, poor institutions, lack of financial intermediation, etc.<sup>3</sup>

External shocks and domestic policies could affect total factor productivity (TFP) through a number of ways. When foreign exchange access is controlled, there is frequently preferential treatment for the import of investment goods. Moreover, inappropriate levels of the official exchange rate proxied by the black market premium are generally inversely associated with "open" trade policies, therefore, the potential impact on productivity. A greater openness facilitates the adoption of more efficient techniques of production leading to foster growth of TFP. The expansion of exports relaxes the foreign exchange constraint and allows for larger imports of key inputs in the production process.<sup>4</sup> For the domestic factors, the variation in the level of education embodied in the labour force is one of the primary reasons for the observed differences in productivity among countries.<sup>5</sup> For SSA countries particularly, the relevant bottleneck preventing the adoption of new technology is the lack of human capital necessary to implement the new technology in a productive fashion (Miller and Upadhyay, 2000). A poor state of infrastructure makes the supply of inputs unreliable, and can hinder growth by depressing the marginal product of private investments. The heavy regulation of financial markets-the direction of bank loans to state enterprises or "strategic" sectors-may have a negative impact on growth.

Concerning the empirical literature, the search for the roots of SSA's growth is hardly new. Islam (1995), O'Connell and Ndulu (2000) among others used the panel regression framework to estimate productivity levels in a sample of 96 and 85 countries respectively. However, productivity indices are computed in these studies using three-year or five-year panel data. Moreover, in these studies SSA and developed countries are put together implying that they have the same production technology, which is quite unrealistic. The empirical studies on the international comparison of TFP generally uses three different approaches, namely (a) time-series growth accounting approach, (b) cross-section growth accounting approach and (c) panel regression approach.<sup>6</sup> In the growth accounting approach<sup>7</sup>, the main focus is on the proportion issue. This concerns the issue of how much of output growth can be

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<sup>2</sup> Relative to other developing regions for instance, Collier and Gunning (1999) found that the parallel market exchange rate premium is 40.0 in SSA and 26.0 in other Least Developed Countries (LDCs). The quantitative restrictions between 1988-1990 is 46.0% in SSA and 21.0% in other LDCs while the terms of trade volatility is 16.4 in SSA and 12.8 in other LDCs.

<sup>3</sup> See Savides (1995) and Easterly and Levine (1997) among others for a review of the evidence.

<sup>4</sup> See Edwards (1998) among others for more developments.

<sup>5</sup> See Barro (1991), Mankiv et al. (1992), Levine and Renelt (1992), and Saarenheimo (1993) among others for empirical studies stressing the importance of the local level of human capital on growth.

<sup>6</sup> See Islam (1999) among others for a compact review and application of these methodologies.

<sup>7</sup> See Abramovitz (1956) and Solow (1957) among others for more developments.



explained by measured input growth and how much is left to TFP growth. However, the main drawback of this approach is the requirement of equilibrium assumption to hold permanently, and the fact that a substantial part of the productivity is left unexplained. Also, time-series growth accounting generally requires data for a long period of time. Due to data requirements, this approach to international TFP comparisons has generally remained limited to developed countries e.g. the G-7 or the OECD countries. Finally, the problem with the cross-section growth accounting approach is related to the requirement of prior ordering of countries, since TFP indices may be sensitive to the ordering chosen. One of the merits of the panel regression approach is that it provides TFP dynamics. Yet it is dynamics that can better reveal the determinants of TFP. This paper applies the panel regression approach to produce TFP indices and to shed light on the sources of TFP in a sample of 27 SSA countries.<sup>8</sup>

The rest of the paper is structured as follows. Section 2 presents the methodology. Section 3 presents the empirical results and section 4 concludes and gives the policy implications of the findings of the findings.

## 2. Methodology

Following Miller and Upadhyay (2000) we adopt a Cobb-Douglas production function that includes and excludes human capital as input.<sup>9</sup> Our analysis involves one step i.e. the determinants of TFP are directly included in the production function as inputs and all variables are simultaneously estimated. The two production functions excluding and including the stock of human capital are expressed as follows:

$$Y = AK^\alpha L^\beta Z^\theta, \quad 0 < \alpha < 1 \quad \text{and} \quad 0 < \beta < 1 \quad (1)$$

$$Y = AK^\alpha H^\gamma L^\beta Z^\theta, \quad 0 < \alpha < 1, \quad 0 < \gamma < 1 \quad \text{and} \quad 0 < \beta < 1 \quad (2)$$

where Y is real GDP, K is the total physical capital stock, L is the number of workers (labour force), H is the measure of human capital, Z stands for the sources of TFP, and A is an index of TFP. We allow for the possibility of non-constant returns to scale by not restricting  $(\alpha + \beta)$  or  $(\alpha + \beta + \gamma)$  to equal one.

Dividing all variables (except the sources of TFP i.e. the Z variables) in equations (1) and (2) by the labour force (L) expresses output, the physical stock of capital and the human capital stock on a per worker basis. That is,

$$y = Ak^\alpha L^{\alpha+\beta-1} Z^\theta \quad (3)$$

$$y = Ak^\alpha h^\gamma L^{\alpha+\beta+\gamma-1} Z^\theta \quad (4)$$

where y is real GDP per worker, k is the per worker stock of physical capital, h is the per worker stock of human capital. The production functions (3) and (4) display increasing, constant or decreasing returns to scale as  $(\alpha + \beta)$  or  $(\alpha + \beta + \gamma)$  are greater than, equal to, or less than one, respectively. Rewriting equations (3) and (4) in natural logarithms and by taking into account the possible country-specific or time-specific effects yields the following equations

$$\ln y = \ln A + \alpha \ln k + (\alpha + \beta - 1) \ln L + \theta \ln Z_{it} + \mu_i + \nu_{it} \quad (5)$$

$$\ln y = \ln A + \alpha \ln k + \gamma \ln h + (\alpha + \beta + \gamma - 1) \ln L + \theta \ln Z_{it} + \mu_i + \nu_{it} \quad (6)$$

<sup>8</sup> See Appendix for the list of countries, which are selected by data availability.

<sup>9</sup> Although there is no consensus yet about the precise way in which human capital should enter the aggregate production function, researchers have all along recognised the importance of human capital in creation of income and growth. See Benhabib and Spiegel (1994) and Islam (1995 and 2003) for more developments.

where  $\mu_{it}$  is the individual country effect and  $\nu_{it}$  is the error term assumed to be zero on average and uncorrelated with regressors. Thus constant returns to scale implies that the coefficients on  $\ln L$  equal zero.

We focus on the fixed-effects. First, we control for unobserved country-specific differences in growth rates by including dummy variables for each country.<sup>10</sup> Second, we consider possible time-specific effects. This is based on the use of year-specific dummies. Indeed, the time-specific component accounts for the cyclical effects, changes in the technology, and other possible effects common to all SSA countries in each year.<sup>11</sup> The estimated equations are as follows,

$$\ln y = \ln A + \alpha \ln k + (\alpha + \beta - 1) \ln L + \theta \ln Z_{it} + \sum_{j=1}^{27} \delta_j \text{dummy}_j + T_t + \mu_i + \nu_{it} \quad (7)$$

$$\ln y = \ln A + \alpha \ln k + \gamma \ln h + (\alpha + \beta + \gamma - 1) \ln L + \theta \ln Z_{it} + \sum_{j=1}^{27} \delta_j \text{dummy}_j + T_t + \mu_i + \nu_{it} \quad (8)$$

where  $\text{dummy}_j$  ( $j=1,2, \dots, 27$ ) represents the country dummy variables and  $T_t$  is year dummy for period  $t$

In the previous methods, the production possibilities are assumed to be the same across countries, which is quite restrictive. Therefore, we finally test the assumption of similar technology across country using the Seemingly Unrelated Regression (SUR) model. In the SUR model, the errors are independent over time but correlated across cross-section units/countries.

We finally calculate the country-specific fixed effects of intercepts as follows,

$$\hat{\mu}_i = \ln y_{it} - \hat{\alpha} \ln k_{it} - \hat{\delta}_1 \ln L_{it} - \hat{\theta} \ln Z_{it} \quad (9)$$

$$\hat{\mu}_i = \ln y_{it} - \hat{\alpha} \ln k_{it} - \hat{\gamma} \ln h_{it} - \hat{\delta}_2 \ln L_{it} - \hat{\theta} \ln Z_{it} \quad (10)$$

where a caret over a parameter indicates the estimate of that parameter,  $\delta_1 = (\alpha + \beta - 1)$  and  $\delta_2 = (\alpha + \beta + \gamma - 1)$  and  $i=(1,2,3,\dots,27)$  is the index across the 27 SSA countries.

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<sup>10</sup> An F-statistic is considered to check for the necessity of introducing the country effects.

<sup>11</sup> An F-statistic test is also considered to check the necessity of introducing the temporal effects.

### 3. Empirical results

When dealing with time series data it is important to first examine whether the variables grow over time that is the extent to which they are non-stationary. Therefore, all the variables were stationarized using the ADF and Wald tests (see Appendix Table A<sub>1</sub> for the definitions and sources of data). The results reported in Table 2 show that the logarithm levels of all variables are stationary.

**Table 2: Results of unit roots test**

Variable	ADF test	Wald test
Ln <sub>y</sub>	-5.68*	2.0782*
Ln <sub>k</sub>	-4.908*	4.2494*
Ln <sub>L</sub>	-10.328*	2.6984*
Ln <sub>h</sub>	-6.408*	4.8818*
Ln <sub>Open</sub>	-4.237*	4.3509*
Ln <sub>Stot</sub>	-8.221*	5.23*
Ln <sub>Invest</sub>	-5.702*	0.9064*
Ln <sub>Fina</sub>	-6.698*	5.3859*
Ln <sub>Popg</sub>	-6.717*	10.615*

The variables are defined as follows. Open is openness; stot is variability of tot; Invest is ratio of gross investment to GDP; Fina is the measure of financial depth; and Popg is population growth. The ADF critical values at the 1%, 5% and 10% levels are -3.96, -3.41 and -3.12 respectively. The Chi-square Wald critical values at the 1%, 5% and 10% levels are respectively 0.872, 1.64 and 2.2. \* means significant at the 1% level.

The first set of regression results using the pure cross-section (averages of time series for each country) are presented in Table 3. The coefficient estimates reported in columns (i) and (ii) in Table 3 stand for the production function excluding and including human capital. For this pure cross-country regression, real GDP par capita in 1965 is also included as an independent variable. This is to test for the convergence hypothesis given that the neoclassical growth models predict that per capita growth rates tend to be inversely related to initial GDP per capita.<sup>12</sup> For both production functions initial GDP per capita is insignificant suggesting that SSA countries did not exhibit any convergence in growth rates after accounting for other factors. Concerning the production function excluding human capital, the coefficient on labour (ln<sub>L</sub>) is positive and significant at the 1% level. This implies that the production function without human capital exhibits increasing returns to scale.<sup>13</sup> The coefficient on per worker stock of physical capital (ln<sub>k</sub>) is positive and significant at the 1% level. The two coefficients on ln<sub>L</sub> and ln<sub>k</sub> combine to generate the implied elasticity of output with respect to the labour of 0.7906.<sup>14</sup> The output elasticities with respect to labour and physical capital sum to a value of 1.2795, which is higher than one corroborating the fact that the production function excluding human capital displays increasing returns to scale. Concerning the estimates of column (ii), the output elasticity with respect to human capital per worker is positive but insignificant. The combined elasticity of output with respect to physical and human capital totals 0.9718, and the implied elasticity of output with respect to the labour

<sup>12</sup> See Barro (1991) and Harrison (1996) for more developments.

<sup>13</sup> The coefficient of ln<sub>L</sub> is equal to  $\alpha + \beta - 1$ , therefore the existence of increasing returns to scale if this coefficient is positive.

<sup>14</sup> The value of 0.7906 is obtained by solving for  $\beta$  in the following equation,  $\alpha + \beta - 1 = 0.2795$  with  $\alpha = 0.4889$ .

force falls to 0.3101, implying that the coefficient of labour in the production function without human capital captures much of the influence of human capital. We also incorporate human capital into the production function using the interaction of human capital with either physical capital or the labour force. The results reported respectively in columns (iii) and (iv) show that the elasticity of output with respect to physical capital is significantly affected by the stock of human capital while the elasticity of output with respect to labour is not. Therefore, the evidence suggests once again a link between human capital and physical capital rather than human capital and the labour force. Regarding the determinants of TFP, the results of columns (i) and (ii) in Table 3 show that the coefficient on openness (lnOpen) is negative and significant at the 1% level. One possible reason for the significant negative impact of openness is the existence of considerable supply constraints in the African continent, which hinder SSA countries to cope with competition following the openness of the trade regime. The population growth is an important source of growth in SSA. Indeed, the coefficient on this variable (lnPopg) is positive and significant at the 1% level. This result differs from the predictions of the Solow model.

**Table 3: Cross-section estimates of production function using 36-year averages (standard errors are within parentheses)**

Variable	(i)	(ii)	(iii)	(iv)
Constant	-0.5601* (.03193)	-0.759* (0.401)	-0.3263* (0.0076)	-0.4059* (0.1805)
lnGDP in 1965	0.0712 (0.1654)	0.0864 (0.1748)	0.0757 (0.1702)	0.0731 (0.17)
lnk	0.4889* (0.1522)	0.4759* (0.1837)	0.4303*** (0.2343)	0.507* (0.1723)
lnL	0.2795* (0.0593)	0.2819* (0.0783)	0.982* (0.2877)	0.8424* (0.2809)
lnh		0.4959 (0.8553)		
lnH*lnk			0.0303** (0.009)	
lnH*lnL				0.0404 (0.1616)
lnH*lnOpen		0.4492 (0.7593)		
lnOpen	-.8922* (0.2441)	-1.7254 (1.4011)	-0.9154* (0.2597)	-0.9108* (0.2615)
lnStot	-.6875 (1.051)	-0.8013 (1.1178)	-0.7481 (1.093)	-0.7218 (1.0882)
lnFina	0.0076 (0.2552)	0.0129 (0.2685)	0.0158 (0.2629)	0.0139 (0.2633)
lnPopg	0.9322* (0.1857)	0.2152* (0.0332)	0.9737* (0.2451)	0.6033* (0.2632)
lnInvest	1.4777 (1.275)	1.1542 (1.4557)	1.309 (1.4009)	1.3618 (1.3894)
R <sup>2</sup>	0.6649	0.6731	0.6671	0.6661
R <sup>2</sup> (adjusted)	0.5159	0.4692	0.4908	0.4893
SEE	1.6674	1.746	1.7101	1.7126
# Observations	27	27	1.7101	27

Notes: \*, \*\* and \*\*\* means significant at the 1%, 5% and 10% levels.

The problem with the previous cross section results however, is the use of period averages, which is likely to hide significant variations in individual country performance. The regressions were rerun using this time annual data for the same variables. Since we include both country and time dummy variables, we cannot include initial per capita GDP. The results of the estimation of Equations (7) and (8) are reported in Table 4.

**Table 4: Fixed effects production function estimates using annual data (standard errors are within parentheses)**

Variable	(i)	(ii)	(iii)	(iv)
lnk	0.3149* (0.0763)	0.3521* (0.0781)	-0.002 (0.0941)	0.3157* (0.0763)
lnL	-0.9056* (0.2715)	-0.9037* (0.3133)	-0.8685* (0.2672)	-0.9989* (0.2915)
lnh		-0.0693 (0.1729)		
lnH*lnk			0.1123** (0.0201)	
lnH*lnL				0.033 (0.0375)
lnH*lnOpen		-0.075** (0.0354)		
lnOpen	-0.5587* (0.0653)	-0.3494* (0.117)	-0.6304* (0.0655)	-0.5551* (0.0654)
lnStot	-.0897** (0.0491)	-0.1058** (0.0497)	-0.0888** (0.0483)	-0.0886** (0.0491)
lnFina	1.7045* (0.1701)	1.6334* (0.1744)	1.5129* (0.1709)	1.6735* (0.1738)
lnPopg	0.0709 (0.1973)	0.0057 (0.1995)	0.0319 (0.1942)	0.0725 (0.1973)
lnInvest	0.6944* (0.1424)	0.6415* (0.1442)	0.7368* (0.1403)	0.6906* (0.1425)
R <sup>2</sup>	0.8365	0.8368	0.8386	0.8365
R <sup>2</sup> (adjusted)	0.7315	0.7368	0.7337	0.7315
SEE	1.3619	1.3595	1.3397	1.3621
# Observations	972	972	972	972

Notes: \*, \*\* and \*\*\* means significant at the 1%, 5% and 10% levels.

The computed F scores to test the necessity of introducing country and time dummies in the regression estimations are respectively 37.6835 and 3.2329. These F values are higher than the 5% critical values of  $F_{(27, 935)}=1.44$  and  $F_{(36, 926)}=1.41$ . Therefore, we rejected the null hypothesis that the restricted and unrestricted specifications were the same and used country and time dummies in the regressions. The estimates of the production function, which excludes human capital, are reported in column (i). The coefficient on labour is negative and significant at the 1% level implying that the production function without human capital exhibits decreasing returns to scale. The coefficient on per worker stock of physical capital is positive and significant at the 1% level. The two coefficients on labour and per worker stock

of physical capital combine to generate the implied elasticity of output with respect to labour of  $-0.2205$ . Thus, after accounting for the country- and time-specific effects, the output elasticities with respect to labour and physical capital sum to a value of  $0.0944$ , which is less than one corroborating the fact that the production function excluding human capital displays decreasing returns to scale. Column (ii) reports the estimates of the production function including the stock of human capital per worker. The output elasticity with respect to human capital is negative and non significant. The output elasticity with respect to physical improved by nearly 12% relative to the specification excluding human capital. The combined elasticity of output, with respect to physical and human capital, totals  $0.2828$ . The implied elasticity of output with respect to the labour force falls to  $-0.1865$ . Thus, the coefficient of labour in the production function without human capital captures much of the influence of the human capital. The coefficient on the interaction variable between human capital and physical capital in column (iii) is positive and significant at the 1% level. Once again, the elasticity of output with respect to physical capital is significantly affected by the stock of human capital. This result corroborates the finding of Miller and Upadhyay (2000).

Concerning the determinants of TFP, the results reported in columns (i) and (ii) of Table 4 show that the coefficient on openness ( $\ln\text{Open}$ ) is negative and highly significant, implying that openness to world trade contributes negatively to TFP in SSA region. This result is opposite to the findings of Savides (1995), Sachs and Warner (1997) and Basu et al. (2000). Our findings also do not confirm the predictions of the outward-oriented trade policies according to which international trade is conducive to faster growth because it promotes competition, encourages learning-by-doing, improves access to trade opportunities, and raises the efficiency of resource allocation.<sup>15</sup> However, our finding should not be interpreted as indicative of the negative impact of outward-orientation on SSA countries' TFP. Our finding rather shows the inability of SSA countries to support competition from outward-orientation. This inability to support competition is primarily due to huge supply constraints the local producers usually face in SSA. These supply constraints are related to poor transport and communication infrastructure, erratic supply of the electric power, corruption and bad governance, cumbersome administration, insufficient education of the labour force, etc. The estimated coefficient associated with the terms of trade variability ( $\ln\text{Stot}$ ) is negative and significant at the 5% level. This result shows the inability of SSA economies to absorb shocks related to terms of trade possibly because of the poor diversification of their export structures. The coefficient on the financial depth ( $\ln\text{Fina}$ ) is positive and significant at the 1% level. Thus, financial development is important for the SSA countries' TFP. For instance, an increase in the credit to the private sector as a percentage of total domestic credit by 10% *ceteris paribus* increases TFP by 1.7%, a dramatic and very significant effect. The coefficient on the gross investment to GDP ratio is positive and significant at the 1% level, implying that the physical capital accumulation is also important for SSA countries' TFP. An increase in the gross investment to GDP ratio by 10% *ceteris paribus* is associated with an increase of nearly 0.7% in the TFP, a modest but highly significant effect. This result supports the findings of Savides (1995) and Tahari et al. (2004). The coefficient associated with the interaction variable between openness and human capital is negative and significant at the 5% level.

According to Harison (1996), one major problem with using the annual data to identify the determinants of long-run growth is that short-term or cyclical fluctuations could affect the observed relationship between policy variables and growth. Therefore, we compute three-year averages for 1965 through 2000. Our panel then combines data in 3-year blocks as follows: 1965-1967, 1968-1970, 1971-1973, 1974-1976, 1977-1979, 1980-1982, 1983-1985, 1986-1988, 1989-1991, 1992-1994, 1995-1997, and 1997-2000. For this 3-year averages regression,

<sup>15</sup> See Rodrik (1993) and Wacziarg (1998) among others.

we re-introduce the initial per capita GDP for each sub-period i.e. the first year in each of the 3-year averages. The results are given in Table 5. With the F-values of 1.6919 and 1.937 respectively, the F-tests reject the null hypothesis that country and time effects are not important in columns (i), (ii), (iii), and (iv). Indeed, the previous computed F-values are higher than the 5% critical values of  $F_{(27, 286)} = 1.49$  and  $F_{(12, 301)} = 1.78$ . The estimates of the production function without human capital are given in columns (i). The coefficient on the initial level of per capita GDP is positive and significant at the 1% level in columns (i) and (ii). This result is inconsistent with the conditional convergence- that is, holding constant other growth determinants; poorer SSA countries do not grow faster than richer ones. The coefficient on the time-specific dummy variables in the production function including human capital show that TFP increases over each 3-year period from 1989-1991 though 1995-1997. The coefficients on labour and per worker stock of physical capital are negative and insignificant. The two coefficients combine to generate the implied elasticity of output with respect to labour of 0.9161. The output elasticities with respect to labour and physical capital sum to a value of 0.9115, implying that the production function without human capital displays decreasing returns to scale. The output elasticity with respect to human capital (column ii) is negative and non significant. Concerning the production function excluding human capital the output elasticity with respect to physical capital improved dramatically, i.e. it moved from a negative value of -0.0046 to a positive value of 0.0127. The combined elasticity of output with respect to physical and human capital totals -0.0249. The implied elasticity of output with respect to labour increases to 0.9711. Thus, the coefficient of labour in the production function excluding human capital captures less of the influence of human capital. As in the case of annual data, the elasticity of output with respect to physical capital is significantly affected by the stock of human capital. Indeed, the coefficient on the interaction variable between human capital and physical capital in column (iii) is positive and significant at the 10% level. For the sources of TFP, the results reported in columns (i) and (ii) of Table 5 show that the openness variable negatively affects TFP but this negative effect is significant at the 1% level only in the case of the production function without human capital. The physical capital accumulation effect is positive and significant at the 1% and 5% levels respectively. For instance, a 10% increase in the gross investment to GDP ratio, other things equal, increases TFP by 0.26% and 0.23% in the production functions excluding and including human capital respectively.

**Table 5: Fixed effects production function estimates using 3-year averages (standard errors are within parentheses)**

Variable	(i)	(ii)	(iii)	(iv)
lnGDP in 1965	0.8978* (0.0193)	0.8939* (0.0127)	0.8921* (0.0197)	0.8978* (0.0194)
lnk	-0.0046 (0.0565)	0.0127 (0.0577)	-0.0645 (0.0698)	0.0054 (0.0566)
lnL	-0.0885 (0.3319)	-0.0538 (0.3422)	-0.0527 (0.3322)	-0.1249 (0.3378)
lnh		-0.0376 (0.1039)		
lnH*lnk			0.0195*** (0.0134)	
lnH*lnL				0.0133 (0.0221)
lnH*lnOpen		-0.034 (0.0224)		
lnOpen	-0.1073* (0.0463)	-0.0161 (0.0757)	-0.1293* (0.0485)	-0.1074* (0.0463)
lnStot	0.0402 (0.0383)	0.0284 (0.0391)	0.042 (0.0382)	0.0413 (0.0413)
lnFina	0.0112 (0.0317)	0.0128 (0.0317)	0.0063 (0.0318)	0.011 (0.0317)
lnPopg	0.0817 (0.1292)	0.1008 (0.1315)	0.1126 (0.1307)	0.0965 (0.1317)
lnInvest	0.2565* (0.1139)	0.2289** (0.115)	0.2775* (0.1145)	0.2547* (0.114)
R <sup>2</sup>	0.7923	0.8924	0.6249	0.6923
R <sup>2</sup> (adjusted)	0.6891	0.7199	0.5911	0.6391
SEE	0.4866	0.486	0.4856	1.3621
# Observations	324	324	324	324

Notes: \*, \*\* and \*\*\* means significant at the 1%, 5% and 10% levels.

The main problem with the fixed effects estimations using annual data and 3-year averages is that by pooling all the 27 SSA countries we assumed that they have the same production technology, which is quite restrictive. Moreover, the disturbance in the production equations certainly include factors that are common to all SSA countries such as tropical climate, presence of malaria, as well as factors that are specific to a particular country (e.g. landlockedness, institutional quality, natural resource abundance, etc.). Therefore, there might be some common factors influencing the disturbances in the different equations that have not been specified explicitly in the model. In order to gain more efficiency in the estimates, we jointly estimated all the equations using the generalised least squares. By relaxing the constraint that all the 27 SSA countries have the same parameter vector, we obtained a 27-equation seemingly unrelated regression model (SUR) reported in Appendix Table A<sub>2</sub>. The F statistic for testing the hypothesis of equal parameter vectors in all 27-production functions including and excluding the human capital are 133.78 and 2289.79 with 78, 104 and (972-81), (972-108) degrees of freedom. These values are obviously larger than the critical values. So, the hypothesis of parameter homogeneity across SSA countries is rejected.



Concerning the estimates of the production function without human capital, the results in Appendix Table A<sub>2</sub> indicate that the coefficient on labour (lnL) is negative and significant at the 1% and 5% levels in sixteen of twenty seven countries under study. This implies that the production function without human capital exhibits decreasing returns to scale in these countries. The estimate associated with labour is positive and significant at the 1% level in seven countries implying the existence of increasing returns to scale in these countries. The coefficient on per worker stock of physical capital is negative and significant at the 1%, 5%, and 10% levels in seven countries. In eleven countries the coefficient associated with per worker stock of physical capital is positive and significant at the 1% and 5% levels. The two coefficients combine to generate the implied elasticity of output with respect to labour of each SSA country. The results are reported in Appendix Table A<sub>3</sub>. The SUR estimates of the production function including human capital show that the coefficient on labour is negative and significant in nineteen countries and positive and significant in five countries. These results imply that the production function with human capital exhibits decreasing returns to scale in nineteen SSA countries and increasing returns to scale in five SSA countries. The coefficient on per worker stock of physical capital is negative and significant at the 1% level in Zambia, Madagascar, and Malawi, and positive and significant in Congo Republic, Ghana, Côte d'Ivoire, Niger, Sudan Tanzania, Uganda, and The Gambia. The output elasticity with respect to human capital is positive and significant in Congo Republic, Democratic Republic of Congo (DRC), Mauritius, Rwanda, Kenya, and Nigeria, Benin, Madagascar, and Sierra Leone. The two coefficients on physical and human capital combine to generate the implied elasticity of output with respect to labour of each SSA country. The results are also reported in Appendix Table A<sub>2</sub>. The SUR estimates also show that the elasticity of output with respect to physical capital is significantly affected by the stock of human capital in 18 of the 27 SSA countries under study implying a link between human and physical capital in these countries. The elasticity of output with respect to labour is significantly affected by the stock of human capital in 19 of the 27 SSA countries under study. This implies a link between human capital and labour in these SSA economies.

Concerning the sources of TFP, the SUR estimates of the production function without human capital in Appendix Table A<sub>2</sub> show that the openness negatively and significantly affects TFP in eighteen SSA countries, namely Burkina Faso, DRC, Gabon, The Gambia, Ghana, Côte-d'Ivoire, Kenya, Madagascar, Malawi, Mauritius, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, and Zambia. This result partly shows the inability of these countries to support foreign competition possibly because of considerable supply constraints. The openness has a positive and significant effect on TFP in Cameroon, Chad, Congo Republic, Mali, Uganda, and Zimbabwe. Thus, a more open economy, other things equal, is associated with higher TFP in these countries. The effect of terms of trade variability is negative and significant in Benin, Burkina Faso, DRC, Nigeria while the terms of trade variability has a positive and significant effect on TFP in Cameroon, Central African Republic (CAR), Ghana, Kenya, Malawi, Mauritius, Niger, Sudan, Tanzania, Togo, Zimbabwe, and Zambia. The coefficient on the gross investment/GDP ratio is positive and significant in CAR, Chad, DRC, Gabon, Kenya, Madagascar, Malawi, Mauritius, Nigeria, Senegal, Sierra Leone, Togo, Zimbabwe, and Zambia. This implies that physical capital accumulation enhances TFP growth for these countries. For instance, if the gross investment/GDP ratio is increased by 10%, other things equal, TFP would increase by 2% in CAR, 0.4% in Chad, 2.7% in DRC, 3% in Gabon, 5% in Kenya, 9.6% in Madagascar, 7.5% in Malawi, 7.8% in Mauritius, 8.2% in Nigeria, 2.1% in Senegal, 33.3% in Sierra Leone, 3.2% in Togo, 6.2% in Zimbabwe, and 32.52% in Zambia. These results support the finding of Ghura and Hadjimichael (1996). The coefficient of the measure of the financial depth is positive and

significant at the 1% and 5% levels in Cameroon, CAR, Côte-d'Ivoire, Kenya, Senegal, Sudan, Tanzania, and Togo implying the importance of the financial intermediation for these economies. For instance, an increase in the credit to private sector as % of total domestic credit by 10%, other things equal, increases the gross output by 8.6% in Cameroon, 1.2% in CAR, 16.04% in Côte-d'Ivoire, 4% in Kenya, 13.2% in Senegal, 24.8% in Sudan, 6.8% in Tanzania, and 2.4% in Togo. These effects are dramatic and very significant. However, the coefficient on the credit to private sector as % of total domestic credit is negative and significant in Benin, Chad, Congo Republic, Gabon, The Gambia, Madagascar, Mauritius, Niger, Uganda, and Zambia. Therefore, the level of financial intermediation in these countries is not conducive to TFP. The coefficient on the population growth is negative and significant in Benin, Burkina Faso, Cameroon, The Gambia, Ghana, Madagascar, Malawi, Rwanda, and Sierra Leone corroborating the predictions of the Solow model. For instance, an increase in the annual growth rate of population by one percentage point, other things equal, reduces the gross output by 1.8% in Benin, 2.3% in Burkina Faso, 1.9% in Cameroon, 2.7% in The Gambia, 2.02% in Ghana, 1.2% in Madagascar, 1.6% in Malawi, 0.1% in Rwanda, and 5.9% in Sierra Leone. However, in CAR, DRC, Gabon, Kenya, Mali, Mauritius, Niger, Senegal, Sudan, Tanzania, Uganda, Zimbabwe, and Zambia, population growth is rather conducive to TFP since the coefficient on the population growth variable is positive and very significant. For instance, an increase in the annual growth rate of population by 1%, other things equal, increases the gross output by 0.2% in CAR, 13.4% in DRC, 0.1% in Gabon, 1.7% in Kenya, 0.5% in Mali, 0.24% in Mauritius, 0.62% in Niger, 0.91% in Senegal, 0.41% in Sudan, 3.3% in Tanzania, 0.3% in Togo, 0.44% in Uganda, 2.7% in Zimbabwe, and 14.4% in Zambia.

Concerning the production function including human capital, the SUR results also given in Appendix Table A<sub>2</sub> show that the coefficient on openness is negative and significant in Benin, Congo Republic, Gabon, Côte-d'Ivoire, Kenya, Madagascar, Mauritius, Niger, Nigeria, Rwanda, and Togo. This implies the inability of these countries to cope with foreign competition following the openness of the trade regime possibly because of the existence of supply conditions previously mentioned. The openness variable positively (and significantly) affects TFP in The Gambia, Mali, Senegal, Sierra Leone, Uganda, Zimbabwe, and Zambia; This result then provides support that the SSA countries with higher trade sector as measured by the trade (exports plus imports)/GDP ratio tend to have higher levels of TFP. For instance, a 1% increase in the trade/GDP ratio, other thing equal, raises TFP by 7.5% in The Gambia, 0.3% in Mali, 1.1% in Senegal, 4.5% in Sierra Leone, 1.6% in Uganda, 2.2% in Zimbabwe, and 9.8% in Zambia. The volatility of the terms of trade has a negative (and significant) impact on TFP in Benin, Burkina Faso, in Chad. Contrary to our expectations, the volatility of the terms of trade positively and significantly affects TFP in Ghana, Kenya, Malawi, Mauritius, Niger, Senegal, Tanzania, Togo, and Zimbabwe. This result implies that the structure of exports is possibly diversified in these SSA economies. Physical capital accumulation is conducive to TFP in CAR, DRC, Gabon, Kenya, Madagascar, Malawi, Mauritius, Senegal, Sierra Leone, Togo, Zimbabwe, and Zambia. For instance, a 10% increase in the gross investment/GDP ratio, other things equal, increases the gross output by 0.1% in CAR, 2.1% in DRC, 0.61% in Gabon, 0.3% in Kenya, 0.62% in Madagascar, 0.4% in Malawi, 0.85% in Mauritius, 0.24% in Senegal, 3.7% in Sierra Leone, 0.27% in Togo, 0.67% in Zimbabwe, and 1.8% in Zambia. The credit to private sector as % of total domestic credit positively (and significantly) affects TFP in Cameroon, Côte-d'Ivoire, Senegal, Tanzania, and Togo implying that the size of the financial sector in these economies contributes significantly to TFP: a 1% increase in the credit to private sector as % of total domestic credit increases TFP by 0.64% in Cameroon, 1.5% in Côte-d'Ivoire, 0.16% in Rwanda, 0.68% in Senegal, 0.42% in Tanzania, and 0.18% in Togo. However, the size of the financial sector is a real issue for TFP in Benin, Burkina Faso, CAR, Cha, Congo Republic, DRC, Gabon, Kenya, and

Zambia. Indeed, the coefficient on the credit to private sector as percentage of total domestic credit is negative and significant in these countries. Population growth has a significant negative impact on TFP in eleven SSA countries. For instance, a 1% increase in the annual growth rate of the population, other things equal, decreases the gross output by 2.04% in Benin, 2.84% in Burkina Faso, 1.2% in Cameroon, 0.88% in Chad, 2.3% in Ghana, 1.8% in Madagascar, 1.14% in Malawi, 1.1% in Senegal, 5.7% in Sierra Leone, 2.5% in Tanzania, and 1.3% in Uganda. In another eleven SSA countries, the population growth rather exerts a positive and significant impact on TFP. For instance, a 1% increase in the annual growth rate of population, other things equal, increases the gross output by 1.8% in CAR, 17% in DRC, 1.3% in Kenya, 0.61% in Mali, 0.18% in Mauritius, 0.9% in Niger, 0.1% in Rwanda, 0.28% in Sudan, 0.29% in Togo, 2.3% in Zimbabwe, and 8.1% in Zambia. The coefficient on the interaction variable between openness and human capital is positive and significant in Benin, Congo Republic, Kenya, Niger, Nigeria, and Rwanda. However, the interaction variable between openness and human capital exerts a detrimental impact on TFP in Burkina Faso, The Gambia, Malawi, Mali, Senegal, Sierra Leone, Uganda, Zimbabwe, and Zambia.

We employ the estimates of columns (i) and (ii) in Tables 4 and 5, and the SUR estimates in Appendix Table A<sub>2</sub> to produce TFP estimates for each country over time. The ranking of the 27 SSA countries under investigation for the two different estimates of TFP averaged over time is reported in Appendix Table A<sub>4</sub>. The results show that in the estimations using annual data, 3-year averages, and SUR, the two rankings of TFP possess a rank correlation of 0.9544, 0.8775, and 0.641 respectively implying a consistent pattern across the two different estimates of TFP. Table 6 reports the growth rate of the two different estimates of TFP for subregions and subperiods. Drawing heavily from Tahari et al. (2004), the different SSA subregions taken into consideration are (i) low-income countries (LICs) i.e. countries with 1999 per capita gross national income (GNI) of \$755 or lower, (ii) middle-income countries (MICs) i.e. countries with per capita GNI in the range \$756-\$9,265, (iii) oil producing countries, (iv) conflict countries i.e. countries that have experienced conflicts since 1995, (v) CFA zone countries, and (vi) landlocked countries i.e. countries with no direct access to the sea (see Appendix Table A<sub>5</sub> for the list of the different subgroups of SSA countries). Concerning the subperiods, the analysis of TFP growth is done for the full period 1965-2000 and the performance is compared over two recent subperiods, namely 1991-1995 and 1996-2000 (Appendix Table A<sub>6</sub> reports the growth performance in individual countries during 1965-2000).

**Table 6: Total factor productivity growth (%) by subgroups of SSA countries, 1965-2000**

Subregion	1965-2000		1991-1995		1996-2000	
	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>
TFP estimates using annual data						
SSA	5.5673	-0.4741	11.3862	11.4081	6.1692	9.2787
Non-CFA	10.4922	-2.8327	25.6852	29.6348	3.108	3.2925
CFA	0.6765	2.4741	-6.4876	-6.5456	9.9958	16.7795
• Central Africa	-0.8309	3.208	-17.7427	-18.0318	22.5195	38.6702
• West Africa	1.7532	1.9501	1.5517	1.6589	1.0502	1.1434
Low income	11.1821	-3.0172	25.5785	29.9082	3.488	3.6911
Middle income	1.1594	1.1848	-0.7058	-0.4919	1.8191	1.9941
Oil-producing	27.3302	-16.6297	31.0631	43.8846	29.1011	49.4024
Nonoil-producing	2.4263	2.3182	7.9607	8.2314	2.1811	2.3101
Conflict	0.5285	1.4745	-5.1222	-5.0535	19.2958	2.552
Non-conflict	7.73	-1.0308	16.1028	18.8712	2.4188	32.8582
Landlocked	3.1341	3.982	12.5393	12.9361	3.2807	3.441
Non-landlocked	7.6408	-2.7065	10.8096	13.8639	7.6135	12.2096
TFP estimates using 3-year averages						
SSA	1.6633	1.7416	7.9808	7.9927	-1.6832	-1.5967
Non-CFA	2.2898	2.3331	10.9415	11.097	-4.0435	-3.9372
CFA	0.8801	1.0022	4.2799	4.1124	1.2673	1.3288
• Central Africa	1.9289	1.9837	10.0428	9.5145	1.5201	1.6667
• West Africa	0.131	0.3012	0.1635	0.2538	1.0867	1.0874
Low income	1.0819	1.2033	5.8434	6.1063	-3.3922	-3.3171
Middle income	2.7857	2.6343	4.8591	4.4052	-5.8229	-5.3102
Oil-producing	4.329	4.1357	12.859	12.1289	1.6983	1.886
Non oil-producing	1.1997	1.3252	7.1324	7.2734	-2.2712	-2.2024
Conflict	3.7686	3.7354	4.4936	4.6266	-2.2272	-2.1443
Non-conflict	1.0618	1.1719	20.1859	19.7741	0.2209	0.3199
Landlocked	0.589	0.8554	5.6232	6.1435	0.104	-0.109
Non-landlocked	2.2004	2.1847	9.1596	8.9173	-2.5768	-2.3406
SUR TFP estimates						
SSA	-6.2867	23.4136	-1.954	-5.5453	4.1361	2.6349
Non-CFA	-10.6859	42.6346	-3.7958	-9.2826	7.7948	4.6904
CFA	-0.7877	-0.6125	0.3483	0.8763	-0.4372	0.0656
• Central Africa	0.2457	0.4816	0.9334	2.5822	-1.2198	-0.7701
• West Africa	-1.5259	-1.3941	-0.0695	-0.3421	0.1218	0.6625
Low income	-5.3191	48.8292	-5.851	-10.5323	5.506	2.0827
Middle income	0.4155	1.1177	3.3526	5.2367	-0.151	-1.0094
Oil-producing	1.6901	-1.0866	-3.9904	-2.4938	5.0598	6.3454
Nonoil-producing	-7.674	27.6446	-1.5998	-6.2499	3.9755	1.9896
Conflict	-16.5423	-1.2113	-4.0015	-7.0857	4.8682	1.4944
Non-conflict	-3.3566	30.4493	5.2123	-65.5337	1.5738	6.6266
Landlocked	-0.6976	1.6344	-9.1138	-15.045	2.6189	0.1007
Non-landlocked	-9.064	-0.5847	1.626	-3.2954	4.8947	3.902

During 1965-2000 and for the estimates using annual data, the results in Table 6 show that TFP excluding human capital grew on average at the rate of 5.6% while the TFP including human capital declined on average at the rate of 0.5% in SSA region. Therefore, the productive performance of the region as a whole was very weak and even negative during 1965-2000, corroborating the findings of Tahari et al. (2004). Six countries, namely Kenya, Nigeria, Rwanda, Sudan, Uganda, and Zimbabwe registered an average growth rate of TFP excluding human capital of at least 5% during 1965-2000 while five countries (Congo Republic, Kenya, Uganda, Zimbabwe, and Zambia) registered an average growth rate of TFP including human capital of at least 5% during 1965-2000. Turning to the subgroups of countries and for TFP excluding human capital, the non-CFA countries with an average growth of 10.5% better performed than the CFA ones (average growth rate of TFP of 0.7%). Within the CFA countries, the West Africa CFA countries better performed than the Central Africa ones. The same pattern is observed during the 1991-1995 period. However, during the 1996-2000 subperiod, the CFA countries performed better than the non-CFA countries. Within the CFA countries the Central Africa CFA countries far better performed than the West Africa CFA countries. During the 1965-2000 period the LICs better performed than the MICs. During the 1991-1995 and 1996-2000 subperiods the same pattern is observed. During 1965-2000 as well as during the two recent subperiods of 1991-1995 and 1996-2000, the oil exporting countries were more productive than the non-oil producing ones; the non-conflict countries better performed than the conflict ones; and the landlocked countries were less productive than the non-landlocked countries. During the time span 1991-1995, the TFP (excluding and including human capital) increased by nearly 11.4% on average in SSA. The non-CFA countries experienced the fastest growth in TFP while the CFA countries had a negative growth performance with the Central Africa CFA countries registering the worst record. The LICs better performed than the MICs; the oil producing countries experienced a boost in TFP; growth performance deteriorated in conflict countries; and non-landlocked countries performed better than the landlocked ones. During the subperiod 1996-2000, the SSA region experienced positive growth in TFP excluding and including human capital. The CFA countries performed better than the non-CFA countries. Within the CFA countries, the Central Africa countries were more productive than the West Africa ones. The LICs were more productive than the MICs ones; oil producing countries experienced the fastest TFP growth while the non-oil producing ones experienced the weakest growth performance; non-conflict countries experienced a better TFP growth performance than the countries mired in conflict; and the non-landlocked countries were more productive than the landlocked countries.

Concerning the estimates using data in 3-year averages the results in Table 6 indicate that during 1965-2000 the growth rate of the TFP excluding and including human capital was very weak in SSA (an average growth rate of 1.7%). During the same period, the non-CFA countries were more productive than the CFA ones, and within the CFA countries, the Central Africa ones better performed than the West Africa CFA countries. The MICs were more productive than the LICs. The oil-producing countries had better performances than the non oil-producing ones, and the non-landlocked countries experienced a better growth in TFP than the landlocked ones. During the time span 1991-1995, although the levels of TFP growth were higher relative to the 1965-2000 levels, the same patterns were observed for the SSA as a whole and in the subgroups of countries. During the subperiod 1996-2000, TFP excluding and including human capital dropped in SSA. The non-CFA, LICs, MICs, non-oil producing, conflict, and non-landlocked countries experienced negative growth in TFP.

Concerning finally the SUR estimates, the results in Table 6 show that during 1965-2000 the TFP excluding human capital dropped by nearly 6.3% on average in the SSA. Two countries (Madagascar and Nigeria) registered an average growth rate of TFP of at least 5%

during 1965-2000. The non-CFA, CFA, LICs, non-oil producing, landlocked, and non-landlocked countries also experienced a drop in TFP excluding human capital. When human capital is taken into account in the estimation of the production function, the average growth rate of TFP of the SSA region as a whole became positive (23.4% growth of TFP on average). The CFA, oil producing, and non-landlocked countries registered negative growth in TFP including human capital. The rest of the subgroups of countries experienced a boost in TFP including human capital during 1965-2000. During the subperiod 1991-1995, the SSA region also experienced a drop in TFP excluding and including human capital. The non-CFA, LICs, oil producing, non-oil producing, conflict, and landlocked countries also experienced drop in TFP excluding and including human capital. During the time span 1996-2000, the SSA region registered a positive growth in TFP. The non-CFA countries better performed than the CFA countries. The West Africa CFA countries experienced a boost in TFP while the Central Africa CFA countries experienced a drop in TFP. The LICs experienced an increase in TFP while the MICs experienced a decrease in TFP. The oil producing countries were more productive than the non-oil producing ones. The conflict countries were less productive (possibly because of the destruction of human and physical capital) than the non-conflict countries, and the landlocked countries were less productive than the non-landlocked countries.

## 4. Conclusion

This paper had two objectives. First, calculate total factor productivity (TFP) for a sample of 27 Sub-Saharan Africa (SSA) countries over the period 1965-2000. Second, evaluate the impact of factors such as openness to world trade, terms trade variability, physical capital accumulation, financial depth, and population growth on the derived TFP indices. The TFP measures were estimated from a parsimonious specification of the aggregate production function involving GDP per capita as the endogenous variable, and as the exogenous variables, capital per capita and the labour force, both with and without the stock of human capital. The production functions were estimated simultaneously i.e. by introducing the determinants of TFP directly in the production function and estimating all the variables. We used (i) the cross-section estimation (use of 36-year averages), (ii) the fixed-effects estimation with annual data, (iii) the fixed effects estimation with data in 3-year averages, and (iv) the seemingly unrelated regression (SUR) technique.

The cross-section and the panel estimation results show that the SSA countries did not exhibit any convergence in growth rates after accounting for other factors. Therefore, poorer SSA countries did not grow faster than richer countries as predicted by the neoclassical growth model. Concerning the determinants of TFP, the cross-section, the fixed-effect using annual data, and the fixed-effect using data in 3-year averages results showed that outward-orientation negatively affected TFP in SSA countries implying the inability of these countries to support competition from outward-orientation. This inability is possibly due to supply constraints such as poor transport and communication infrastructure, erratic supply of electric energy, corruption and bad governance, cumbersome administration, insufficient education of the labour force, etc. the producers usually face in most SSA countries. The results also show that physical capital accumulation is important for the SSA countries TFP.

Concerning the story of each SSA country, the SUR results of the production function excluding human capital indicated that openness negatively and significantly affected TFP in eighteen SSA and had a positive significant effect on TFP of six SSA countries (Cameroon, Chad, Congo Republic, Mali, Uganda, and Zimbabwe). The terms of trade variability had a negative and significant effect on TFP in four SSA countries (Benin, Burkina Faso, DRC, and

Nigeria) and a positive and significant effect on the TFP of twelve SSA countries. Physical capital accumulation is important for fifteen SSA countries. Financial intermediation is also important for eight SSA countries and not conducive for TFP in ten SSA countries. Population growth reduced TFP in nine SSA countries and is conducive to TFP in fourteen SSA countries. For the production function including human capital the SUR results showed that openness negatively and significantly affected TFP in eleven SSA economies and positively (and significantly) affected TFP in seven SSA countries. The volatility of the terms of trade had a negative and significant impact on TFP of three SSA countries and a positive and significant impact on TFP of nine SSA countries. Physical capital accumulation is important for TFP in twelve SSA countries studied. Financial development is conducive to TFP in six SSA economies and it is a matter of concern in ten SSA countries. Population growth reduced TFP in eleven SSA countries and it is conducive to TFP in another eleven SSA economies.

Given the previous results, the economic policy implications in order to improve TFP in SSA region are the following,

- SSA countries should implement outward-oriented trade policies. However, opened trade policies alone are not a panacea. The outward-orientation should be accompanied by sound policies to address issues related to supply conditions such as poor transport and communication infrastructure, volatile supply of electric energy, corruption and bad governance, lack of human capital, etc.
- SSA countries should implement policies conducive to the accumulation of physical and human capital. This means for instance that SSA countries should implement policies conducive to a business-friendly environment i.e. an environment that can attract domestic and foreign investments. Also, these countries should implement policies aiming at training or improving the skill of the labour force.
- SSA countries should implement policies aiming to enlarge the size of the financial sector. Specifically, the SSA countries should increase the volume of the domestic credits granted to the private sector.

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## Appendix

**Table A<sub>1</sub>: Data sources and definitions**

Variables	Definition and construction	Source
Output Real per capita GDP	Ratio of real GDP to economically active population	Author's construction based on data from World Bank (2002)
Capital	The capital stock is calculated using the perpetual inventory method i.e. $K_t = (1 - \delta)K_{t-1} + I_t$ . Like O'Connell and Ndulu (2000) we assume a depreciation rate ( $\delta$ ) of 4% per year. The initial capital stock ( $K_0$ ) is calculated using the approach of Hall and Jones (1999) i.e. $K_0 = (K/Y)_0 = (I/Y) / g_I + \delta$ where $g_I$ is the growth rate of gross investment (I) over the next ten years and $\delta$ is the depreciation rate. <sup>16</sup>	Author's construction based on data from World Bank (2002)
Labour	Economically active population aged 15-64 years	World Bank (2002)
Gross secondary school enrolment	Ratio of total secondary enrolment, regardless of age, to the population of the age group that officially corresponds to that level of education.	World Bank (2002)
Openness	Ratio of exports and imports to GDP	Author's construction based on data from World Bank (2002)
Terms of trade variability	Three-year standard deviation of the terms of trade	World Bank (2002)
Financial depth	Domestic credit to the private sector (% of total domestic credit)	World Bank (2002)
Physical capital accumulation	Ratio of gross investment to GDP	World Bank (2002)
Population Growth	Measured by the annual growth rate (%) of the population	World Bank (2002)
Country-specific effect	Dummy variable for each country	Author's construction
Period-specific effect	Dummy variable for each year.	Author's construction

<sup>16</sup> The capital output ratio  $K/Y$  is assumed to be constant at the steady state, implying that the rates of changes in capital and output are equal.

**Table A<sub>2</sub>: SUR estimates of the production functions excluding and including human capital (standard errors are within parentheses)**

Country	Constant	lnk	lnL	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Benin	18.4161* (4.5447)	0.0301 (0.0718)	-2.7598* (1.1689)	-0.0121 (0.0356)	-0.0523* (0.0143)	-0.2494* (0.0934)	-1.7708* (0.3942)	-0.4062* (0.1096)	0.4769
Burkina Faso	12.6139* (4.8173)	0.0813* (0.0396)	-1.7965 (1.169)	-0.0753** (0.0411)	-0.0443* (0.0085)	-0.0241 (0.0182)	-2.266* (0.262)	-0.1716* (0.0656)	0.8603
Cameroon	14.2834* (6.8514)	-0.0386* (0.0157)	-2.7105*** (1.5945)	0.1265 (0.047)	0.0222** (0.0122)	0.8584* (0.0627)	-1.9443* (0.6442)	0.0635* (0.0786)	0.8955
CAR	-1.583* (0.6831)	0.0689 (0.0705)	0.784* (0.0901)	-0.0167 (0.0559)	0.0899* (0.0175)	0.1213* (0.00567)	1.04728* (0.0174)	0.1722* (0.066)	0.965
Chad	19.5957* (2.8403)	-0.0465 (0.0309)	-3.2132* (0.8276)	0.1718* (0.0792)	-0.0173 (0.0176)	-0.2344** (0.1196)	-0.1504 (0.1665)	0.0401** (0.0197)	0.8241
Congo Rep.	-1.3272* (0.0414)	0.6291* (0.4324)	0.1514* (0.0061)	1.0361* (0.1992)	-0.0689 (0.1062)	-2.5977** (0.6627)	-1.5824 (1.3288)	-1.814* (0.5172)	0.58
DRC	-3.108* (0.7103)	0.2563* (0.0921)	0.1129* (0.0452)	-0.7262* (0.2982)	-0.4166* (0.191)	-0.171 (0.3342)	13.3572* (5.8366)	2.685* (0.5597)	0.8933
Gabon	7.4362* (0.3475)	0.0746 (0.0292)	-0.8639* (0.0407)	-0.4526* (0.0401)	0.014 (0.0134)	-0.3938* (0.0555)	0.0451*** (0.0273)	0.3474* (0.0751)	0.8752
The Gambia	4.2655* (1.9061)	1.1873* (0.4964)	-0.6415 (0.5261)	-1.0643* (0.2519)	-0.0303 (0.0802)	-0.2092*** (0.1262)	-2.7325* (0.4218)	-0.6762* (0.3179)	0.8108
Ghana	7.7801* (8.6332)	0.8692* (0.0459)	-0.6035 (0.5137)	-4.0122* (0.3633)	0.8795* (0.1391)	-0.0689 (0.326)	-2.0184* (0.4615)	-1.4795* (0.3179)	0.9308
Ivory Coast	1.4704* (0.5745)	0.0964* (0.0172)	-0.9111* (0.0212)	-0.1568* (0.026)	-0.0199 (0.0186)	1.6036* (0.1603)	-0.0155 (0.2147)	-0.1909* (0.054)	0.9744
Kenya	-2.1836 (6.1081)	-0.1811** (0.0928)	0.7317 (1.4963)	-0.3287* (0.0606)	0.0454* (0.0186)	0.3989* (0.1106)	1.6932* (0.3724)	0.504* (0.1488)	0.9476
Madagascar	3.7724* (0.771)	-0.2549* (0.0283)	-0.4052* (0.0688)	-1.1701* (0.1033)	0.038 (0.0298)	-0.8087* (0.1164)	-1.157* (0.3507)	0.9582* (0.2938)	0.8534
Malawi	2.9404* (0.5476)	-0.0647 (0.1331)	-0.3493* (0.0967)	-2.4449* (0.1308)	0.3158* (0.0324)	-0.0306 (0.0858)	-1.5799* (0.3611)	0.7466* (0.1278)	0.8809

**Table A<sub>2</sub> cont...**

Country	Constant	lnk	lnL	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Mali	0.8674* (0.2551)	0.0197 (0.0189)	-0.4251* (0.0409)	0.0786* (0.0356)	0.0164 (0.0126)	0.0481 (0.0547)	0.4997* (0.1169)	-0.2883* (0.0577)	0.8415
Mauritius	-11.0448* (2.721)	0.0209 (0.0439)	3.0685* (0.6495)	-0.9597* (0.0337)	0.0406*** (0.0232)	-0.2089* (0.0783)	0.2413* (0.0985)	0.7838* (0.1202)	0.954
Niger	-3.7749* (0.2816)	0.4326* (0.1151)	0.952* (0.4849)	-0.4256* (0.0404)	0.0767* (0.0172)	-0.1115* (0.0486)	0.6224 (0.2057)	-0.2132* (0.1035)	0.9348
Nigeria	1.4031* (0.526)	-0.5185* (0.1016)	-0.5462* (0.1078)	-0.9722* (0.1188)	-0.1843* (0.0854)	-0.0215 (0.0425)	0.613 (0.6325)	0.8203* (0.3438)	0.7373
Rwanda	2.9436* (0.4043)	0.0741 (0.0731)	-0.2088* (0.0868)	-0.6271* (0.0453)	-0.0036 (0.0352)	0.1161* (0.0776)	-0.0658*** (0.0383)	-0.1486 (0.2172)	0.8062
Senegal	7.4362* (0.3475)	0.0746 (0.0292)	-0.8639* (0.0407)	-0.4526* (0.0401)	0.014 (0.0134)	-0.3938* (0.0555)	0.0451*** (0.0273)	0.3474* (0.0751)	0.9474
Sierra Leone	1.386* (0.5996)	0.0237 (0.136)	-0.7403* (0.1526)	-1.3222* (0.2669)	-0.0073 (0.069)	-0.0435 (0.0923)	-5.9295* (0.6196)	3.3336* (0.3978)	0.9747
Sudan	3.075* (0.8407)	0.8722 (0.8542)	-0.8123* (0.2483)	-0.4064 (0.2707)	0.5832* (0.1036)	2.4821* (0.2767)	0.4088** (0.2109)	-0.0524 (0.5064)	0.9637
Tanzania	1.8359* (0.4595)	0.3096* (0.029)	-0.621* (0.1093)	-1.5131* (0.1743)	0.3954* (0.1022)	0.6824* (0.1047)	3.2603** (1.7809)	-4.2263* (0.7302)	0.9568
Togo	-0.2123* (0.0036)	-0.1168 (0.0741)	0.9065* (0.292)	-0.0949* (0.0425)	0.045* (0.01)	0.0244 (0.0586)	0.2894* (0.0565)	0.3201* (0.0708)	0.9052
Uganda	0.3707 (0.6332)	1.4338* (0.1504)	0.6575* (0.1704)	0.6148* (0.1344)	0.0363 (0.0652)	-0.3752* (0.1221)	0.4431*** (0.2821)	0.0474 (0.2272)	0.9808
Zimbabwe	4.2467* (0.6347)	0.2141* (0.0522)	-0.1195* (0.0653)	0.6112* (0.0775)	0.1375* (0.0345)	-0.2247 (0.1603)	2.6524* (0.2249)	0.6239* (0.1256)	0.9365
Zambia	4.1257* (1.3942)	-0.8714* (0.2535)	-0.8999* (0.2283)	-2.8057* (0.6639)	0.2689** (0.144)	-0.2955* (0.0539)	14.374* (1.808)	3.2522* (0.0751)	0.8844

Table A<sub>2</sub> cont...

Country	Constant	lnk	lnL	lnh	lnOpen	lnH*lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Benin	23.6652* (6.0068)	0.07112 (0.0964)	-4.148* (1.4788)	0.2966** (0.1519)	-0.4465* (0.1729)	0.1764* (0.0629)	-0.0344* (0.0156)	-0.1636** (0.1006)	-2.0373* (0.4709)	-0.3626* (0.1187)	0.494
Burkina Faso	9.9428** (5.5374)	0.0308 (0.065)	-1.0288 (1.3242)	-0.1071 (0.0811)	-0.0058 (0.0761)	-0.1649* (0.0572)	-0.0281* (0.0101)	-0.0424* (0.0209)	-2.8379* (0.326)	-0.1169 (0.0854)	0.8809
Cameroon	23.2063* (6.6971)	-0.0108 (0.0132)	-5.0349* (1.5884)	-0.2355* (0.0864)	0.0026 (0.1262)	0.0449 (0.0499)	-0.0063 (0.0106)	0.6356* (0.0614)	-1.2017* (0.5609)	0.0966 (0.0682)	0.9237
CAR	-9.6714* (5.9081)	0.0539 (0.0606)	0.6213* (0.3547)	-0.2202** (0.1378)	-0.1083 (0.1481)	0.0449 (0.0649)	0.0128 (0.0133)	-0.1022* (0.0461)	1.8153* (0.1499)	0.1143** (0.0577)	0.9856
Chad	8.9873* (2.881)	0.0002 (0.0261)	-0.0626 (0.9703)	0.8963 (0.6951)	-0.1623 (0.1673)	0.08701 (0.0961)	-0.0585* (0.0146)	-0.3835* (0.0933)	-0.8798* (0.1488)	-0.0127 (0.0151)	0.887
Congo Rep.	-1.3962* (0.4826)	0.9693* (0.44)	0.3355* (0.1029)	0.1539* (0.0583)	-1.9701* (0.9762)	0.7282* (0.2607)	0.0601 (0.1091)	-2.6516* (0.69)	0.4565 (1.2912)	-1.3962* (0.4825)	0.5838
DRC	-0.267* (0.0121)	0.6478* (0.1021)	0.5527* (0.0765)	0.5172* (0.294)	-0.9709 (2.1912)	0.1387 (0.7149)	0.0655 (0.0192)	-0.5092** (0.2875)	16.9623* (5.6814)	2.0603* (0.4707)	0.9257
Gabon	8.0767* (0.8457)	0.0073 (0.0326)	-1.0848* (0.2398)	-0.1627 (0.2353)	-0.7955** (0.4317)	0.2072 (0.1681)	-0.0205 (0.0154)	-0.4095* (0.0647)	0.0119 (0.0321)	0.609* (0.0951)	0.9022
The Gambia	1.4675* (0.1572)	0.7613** (0.4234)	-0.04303* (0.1185)	-0.5097* (0.1598)	7.5104* (1.1183)	-2.8282* (0.3713)	-0.0443 (0.057)	-0.1039 (0.1019)	-0.0819 (0.4091)	-0.3299 (0.2299)	0.8917
Ghana	21.1056 (58.2801)	0.1006* (0.0061)	-0.9232 (1.4436)	-0.0509 (0.4899)	-1.6575 (3.4324)	-0.4717 (1.0053)	0.6629* (0.1822)	-0.7371** (0.4224)	-2.3048* (0.5572)	-1.2069* (0.4303)	0.9352
Ivory Coast	1.5764 (1.191)	0.09* (0.0221)	-0.7653* (0.2422)	0.1631 (0.2394)	-0.6397 (0.3957)	0.1675 (0.1336)	-0.0308 (0.0277)	1.4789* (0.2068)	0.0245 (0.2605)	-0.1789* (0.0679)	0.9732
Kenya	13.9846* (6.0156)	0.0775 (0.0908)	-2.6746** (1.446)	0.4647* (0.0835)	-2.3798* (0.0306)	0.8264* (0.1184)	0.0589* (0.0179)	-0.258** (0.1378)	1.302* (0.3539)	0.2966* (0.1405)	0.9682
Madagascar	33.173* (8.4939)	-1.1157* (0.3456)	-0.9209* (0.1544)	0.8724** (0.4761)	-1.6064 (1.0045)	0.2523 (0.3653)	0.0537 (0.0345)	-0.2416 (0.217)	-1.8117* (0.4782)	0.6196** (0.3711)	0.8646
Malawi	2.3824* (0.9873)	-0.319* (0.0976)	-0.5715* (0.0799)	-1.3751* (0.0968)	0.2688 (0.2274)	-0.5023* (0.1293)	0.1692* (0.0269)	-0.0093 (0.0681)	-1.1426* (0.2792)	0.3936* (0.0937)	0.9654
Mali	21.2703* (4.8686)	0.0107 (0.0178)	-0.8242* (0.2222)	-0.3363* (0.0904)	0.4611* (0.0909)	-0.2377* (0.0486)	0.0009 (0.0127)	0.0721 (0.0504)	0.6068* (0.1028)	-0.1258* (0.0588)	0.8905
Mauritius	-4.073 (4.7681)	-0.463 (0.0396)	1.2775 (1.1088)	0.8726* (0.3467)	-0.8492** (0.5037)	-0.0389 (0.1522)	0.0429** (0.0236)	-0.0289 (0.1073)	0.1773** (0.108)	0.9162* (0.215)	0.9583

**Table A<sub>2</sub> cont**

Country	Constant	lnk	lnL	lnh	lnOpen	lnH*lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Niger	-0.9502* (0.0839)	0.3671* (0.1295)	0.3484* (0.0716)	0.5766* (0.1468)	-0.7656* (0.0957)	0.3068* (0.0658)	0.0962* (0.0177)	0.0586 (0.0675)	0.9162* (0.215)	-0.1198 (0.1135)	0.9473
Nigeria	1.7045* (0.3882)	-0.1776 (0.1153)	-0.4217* (0.0419)	-0.7594* (0.2319)	-2.2341* (0.4023)	0.8288* (0.2051)	-0.0034 (0.0894)	0.0737 (0.049)	2.5915 (2.921)	0.0425 (0.3863)	0.8444
Rwanda	29.1164* (10.2416)	0.0456 (0.0767)	-0.7455** (0.5934)	2.7268* (0.6243)	-1.0666* (0.1014)	0.4139* (0.0927)	0.0029 (0.0393)	0.1557** (0.0887)	0.0799** (0.0461)	0.0829 (0.2384)	0.8351
Senegal	2.2036 (10.3587)	-0.0199 (0.0186)	-0.4997 (2.6789)	-1.1855* (0.1536)	1.081* (0.2649)	-0.5757* (0.1097)	0.0255* (0.011)	0.6767* (0.1137)	-1.0624* (0.3474)	0.2392* (0.0603)	0.9732
Sierra Leone	1.4129* (0.9104)	-0.0278 (0.165)	-0.6396* (0.0832)	-0.4093** (0.2406)	4.4992 (3.4803)	-2.0681*** (1.2975)	-0.1469 (0.1042)	0.0497 (0.1353)	-5.74* (0.8564)	3.7338* (0.5982)	0.9749
Sudan	3.9813* (0.2797)	0.3834* (0.0689)	-0.8562* (0.1649)	-1.0975** (0.6596)	-0.9885 (1.1437)	0.2651 (0.4123)	0.3329* (0.0864)	0.3013 (0.3082)	0.2835** (0.161)	-1.8056* (0.4158)	0.9852
Tanzania	3.8464* (0.14205)	0.8059* (0.6799)	-0.2702* (0.0954)	-0.3768* (0.0925)	-1.0077 (0.7049)	0.1653 (0.441)	0.2715* (0.0681)	0.4156* (0.0783)	-2.5008* (1.207)	-2.2919* (0.4919)	0.977
Togo	-3.5411* (0.937)	-0.0684 (0.0855)	0.5008* (0.1376)	0.0391 (0.122)	-0.3937** (0.2189)	0.101 (0.0689)	0.0482* (0.011)	0.1829* (0.0773)	0.2868* (0.0691)	0.2697* (0.0901)	0.8995
Uganda	9.7329* (0.9551)	0.3587* (0.1717)	-2.8523* (0.3352)	-2.5023* (0.2436)	1.6073* (0.186)	-0.9575* (0.1185)	-0.0099 (0.0498)	0.0124 (0.1212)	-1.2969* (0.2967)	0.102 (0.1683)	0.9923
Zimbabwe	67.2869* (10.1959)	0.0224 (0.0679)	-0.331* (0.0595)	-0.1826 (0.133)	2.1771* (0.3798)	-0.8469* (0.1842)	0.0806* (0.0395)	0.238 (0.2017)	2.2829* (0.2584)	0.6701* (0.1494)	0.9437
Zambia	1.9534* (0.7648)	-0.5765* (0.1881)	-0.8773* (0.0799)	-0.4185* (0.0746)	9.8217* (2.8386)	-4.3001* (1.0562)	0.0597 (0.1132)	-0.1466* (0.042)	8.0919* (1.6513)	1.7633* (0.3568)	0.9403

**Table A<sub>2</sub> cont**

Country	Constant	lnk	lnL	lnH*lnlnk	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Benin	19.8614* (5.1707)	0.1199 (0.0986)	-2.9874* (1.2872)	0.0004 (0.0099)	-0.0076 (0.0299)	-0.0523* (0.0124)	-0.2836* (0.0848)	-2.2464* (0.4217)	-0.6032* (0.0978)	0.486
Burkina Faso	16.1771* (5.7522)	-0.1452** (0.0822)	-2.442** (1.3724)	0.0186* (0.0069)	-0.1335* (0.0623)	-0.0156 (0.0107)	-0.0156 (0.0107)	-0.051* (0.0237)	-2.4527* (0.3227)	0.8701
Cameroon	15.4633* (5.7541)	0.0792* (0.0176)	-3.0643* (1.3642)	-0.033 (0.0053)	0.1035 (0.0304)	0.0068 (0.0087)	0.637* (0.0472)	-0.9847* (0.4607)	0.0855*** (0.0563)	0.9253
CAR	-9.2614* (5.2931)	0.1979* (0.0503)	22.3725* (1.3075)	-0.0546* (0.0041)	-0.0507 (0.0366)	0.0177 (0.0123)	-0.1539* (0.043)	1.955* (0.1335)	0.0533 (0.046)	0.9876
Chad	12.3429* (2.4384)	-0.0491* (0.0219)	-1.6749* (0.6521)	0.0324* (0.005)	-0.0804 (0.0587)	-0.0478* (0.0119)	-0.277* (0.0738)	-0.8692* (0.1272)	-0.0167 (0.0115)	0.8901
Congo Rep.	-2.7001* (0.7091)	1.526* (0.533)	0.8018* (0.1841)	0.1557* (0.0589)	0.6807* (0.2397)	0.0214 (0.1096)	-3.2153* (0.7377)	0.1113 (1.3602)	-1.3624* (0.505)	0.5836
DRC	-2.554* (0.7954)	0.6959* (0.0983)	0.3436* (0.0447)	4.2204* (0.7963)	-0.7084* (0.2612)	0.1458 (0.1798)	-0.3561 (0.2794)	21.7682* (4.9727)	1.9449* (0.4578)	0.9254
Gabon	7.413* (0.3787)	0.1491* (0.0445)	-0.905* (0.0479)	-0.0392* (0.0112)	-0.2948* (0.0512)	-0.0058 (0.0149)	-0.3788* (0.0668)	0.0055 (0.0336)	0.5168* (0.0861)	0.8945
The Gambia	64.8522* (28.3186)	-1.7629** (1.1043)	-0.7929* (0.0785)	0.6288* (0.2547)	-0.9706* (0.2786)	0.0413 (0.0757)	-0.0439 (0.1296)	-2.2204* (0.4223)	-0.2943 (0.311)	0.8347
Ghana	36.0854 (49.5127)	0.7765* (0.0514)	-0.7551 (0.8635)	-0.3944* (0.1288)	-2.8615* (0.4918)	0.7593* (0.1365)	-0.1157 (0.3265)	-2.3815* (0.4585)	-1.8109* (0.3144)	0.938
Ivory Coast	1.6339* (0.6166)	0.124* (0.0257)	-0.8994* (0.0217)	-0.0083 (0.0066)	-0.1391* (0.0302)	-0.0369** (0.0186)	1.5802* (0.1683)	-0.09 (0.2182)	-0.196 (0.0583)	0.9755
Kenya	-6.4666 (6.776)	-0.2847* (0.108)	2.06268 (1.6558)	-0.0143* (0.0057)	-0.3121* (0.0691)	0.0709* (0.0234)	0.1485 (0.1514)	1.8484* (0.4262)	0.7657* (0.1771)	0.9565
Madagascar	3.611* (0.8079)	-1.4373* (0.3255)	-0.713* (0.0936)	0.065* (0.0168)	-0.9625* (0.1227)	0.0715 (0.0334)	-0.1642 (0.1829)	-1.6789* (0.4566)	0.7389* (0.3506)	0.8687
Malawi	2.7646* (0.4872)	-0.0163 (0.0923)	-0.2815* (0.0422)	-0.2595* (0.0152)	-0.6682* (0.1166)	0.169* (0.0203)	-0.0701 (0.0537)	-1.2852* (0.2226)	0.4477* (0.083)	0.9443
Mali	2.8653* (0.7463)	0.015 (0.0161)	-0.6797* (0.1949)	0.0034 (0.0055)	0.0785* (0.0242)	0.0145*** (0.009)	0.0146 (0.038)	0.6599* (0.0843)	-0.2655* (0.0449)	0.8425
Mauritius	-1.4147 (4.9708)	-0.5822* (0.2401)	0.6828 (1.2096)	0.1366* (0.0603)	-0.9591* (0.032)	0.0333 (0.0223)	-0.1459** (0.0782)	0.1523 (0.1037)	0.8871* (0.1084)	0.9567

**Table A<sub>2</sub> cont**

	Country	lnk	lnL	lnH*lnlnk	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Niger	-3.3376*	0.4246*	0.8306*	0.0157	-0.5081*	0.0951*	-0.1045**	0.5213*	-0.2271**	0.9389
	(0.8124)	(0.1384)	(0.1471)	(0.0119)	(0.0727)	(0.0202)	(0.0568)	(0.2301)	(0.1272)	
Nigeria	1.6199*	0.6185*	-0.8679*	-0.2133*	-0.7017*	-0.1648*	0.1564*	4.6828**	-0.6557**	0.8438
	(0.1266)	(0.1389)	(0.0654)	(0.0262)	(0.1177)	(0.0804)	(0.0426)	(2.5075)	(0.3394)	
Rwanda	3.1978*	0.081	-0.3469*	-0.0061	-0.6822*	0.0209	-0.0022	-0.0192	-0.0172	0.8028
	(0.5809)	(0.0825)	(0.0908)	(0.0085)	(0.0517)	(0.0392)	(0.084)	(0.0401)	(0.2404)	
Senegal	20.362**	0.1674*	-0.1529**	-0.0766	-0.2439*	0.0103	0.8458*	0.0399	0.3082*	0.9632
	(11.2364)	(0.0438)	(0.088)	(0.0131)	(0.0401)	(0.0124)	(0.1306)	(0.3135)	(0.0684)	
Sierra Leone	1.6963*	0.0887	-0.3758*	-0.0138	-1.3018*	-0.0347	-0.032	-5.8327*	3.3575*	0.9748
	(0.2741)	(0.2264)	(0.0914)	(0.0597)	(0.2766)	(0.0742)	(0.1092)	(0.7687)	(0.475)	
Sudan	3.085*	0.7053*	-0.1681*	-1.3196*	-0.1017	0.3069*	0.6447*	0.4294*	-1.823*	0.986
	(0.1274)	(0.7202)	(0.0055)	(0.127)	(0.1604)	(0.0659)	(0.2108)	(0.1151)	(0.3336)	
Tanzania	-2.3151*	0.3272*	-0.4896*	-0.3093*	-0.8158*	0.2885*	0.4238*	-1.9347**	-2.3151*	0.9769
	(0.3901)	(0.0565)	(0.0796)	(0.0278)	(0.1348)	(0.0555)	(0.0647)	(0.9913)	(0.3901)	
Togo	-1.8517*	-0.0923	0.3454*	-0.0865	-0.0141	0.0383*	0.1923*	0.3766*	0.3493*	0.8985
	(0.0945)	(0.0876)	(0.0536)	(0.0598)	(0.0096)	(0.012)	(0.077)	(0.0705)	(0.0836)	
Uganda	-0.4466	0.6451*	0.977*	-0.3336*	0.9266*	0.0795***	-0.5835*	0.6617*	-0.3164**	0.9815
	(0.5538)	(0.0398)	(0.151)	(0.1216)	(0.1281)	(0.0501)	(0.1182)	(0.2562)	(0.1906)	
Zimbabwe	0.5398*	0.1709	-0.1518*	0.0011	0.5442*	0.1288*	-0.2098	2.9714	0.528*	0.9327
	(0.0635)	(0.1216)	(0.0682)	(0.0279)	(0.0909)	(0.0391)	(0.1858)	(0.2578)	(0.1374)	
Zambia	2.2151*	0.698*	-0.8518*	-0.4695*	-0.9973**	0.0804	-0.1128*	5.5009*	2.5855*	0.9321
	(0.1031)	(0.2624)	(0.0852)	(0.0523)	(0.564)	(0.1196)	(0.0483)	(1.6729)	(0.3838)	



**Table A<sub>2</sub> cont**

Country	Constant	lnk	lnL	lnH*lnlnk	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Benin	16.2366* (5.5117)	0.1713** (0.0927)	-2.1602 (1.3911)	-0.0127 (0.0193)	0.0083 (0.0348)	-0.0491* (0.0142)	-0.2578* (0.0933)	-2.0942* (0.449)	-0.6456* (0.108)	0.4839 ( )
Burkina Faso	13.6971* (5.2766)	-0.077 (0.0678)	-1.8888 (1.2678)	0.0288* (0.0126)	-0.111** (0.0586)	-0.0182** (0.0102)	-0.0473* (0.02556)	-2.4722* (0.3062)	0.0059 (0.0887)	0.8686 ( )
Cameroon	15.141* (6.0161)	0.0034 (0.011)	-2.861 (1.4151)	-0.0711 (0.0117)	0.0966* (0.0321)	0.0093 (0.0089)	0.6311* (0.049)	-0.7776** (0.4902)	0.0741 (0.058)	0.9262 ( )
CAR	-3.6182* (0.4068)	0.0888*** (0.0507)	0.8967* (0.3325)	-0.0882* (0.0068)	-0.0466 (0.0376)	0.0212*** (0.0125)	-0.1411* (0.0434)	1.9084* (0.1371)	0.0335 (0.0474)	0.987 ( )
Chad	13.3878* (2.3851)	-0.009 (0.0222)	-1.9261* (0.6365)	0.0613* (0.0095)	-0.0378 (0.0594)	-0.0471* (0.1203)	-0.282* (0.0736)	-0.8765* (0.1297)	-0.0229* (0.0113)	0.8927 ( )
Congo Rep.	-2.8261* (0.9013)	0.2801* (0.0468)	0.6911* (0.0912)	0.2944* (0.1234)	0.6925* (0.2479)	0.0196 (0.1221)	-3.3706* (0.7827)	-0.7053 (1.5118)	-1.4727* (0.5342)	0.5762 ( )
DRC	-0.951* (0.05042)	0.5747* (0.1002)	0.6481* (0.1006)	1.1762* (0.2125)	-0.6311* (0.2622)	0.2042 (0.1778)	-0.3642 (0.2785)	23.0423 (4.9876)	1.9144* (0.4577)	0.9267 ( )
Gabon	7.4147* (0.3747)	0.0329 (0.033)	-0.6489* (0.033)	-0.0922* (0.0248)	-0.2732* (0.0541)	-0.005 (0.0153)	-0.3881* (0.0663)	0.0174 (0.0342)	0.5447* (0.0882)	0.8963 ( )
The Gambia	0.9153* (0.035)	0.6846 (0.5427)	-0.5257 (0.5975)	0.1327 (0.1075)	-0.9354* (0.2693)	-0.0272 (0.074)	-0.0972 (0.1315)	-2.7019* (0.4133)	-0.6507* (0.2862)	0.8259 ( )
Ghana	0.423 (0.7056)	0.4793* (0.143)	-0.4899* (0.2563)	-0.3626* (0.108)	-0.9265* (0.5084)	0.6415* (0.1411)	-0.3502 (0.332)	-2.2376* (0.4658)	-1.7844* (0.3305)	0.9369 ( )
Ivory Coast	2.1712* (0.7015)	0.0918* (0.0203)	-0.8569* (0.053)	-0.0191 (0.0159)	-0.1652* (0.0345)	-0.0247 (0.0219)	1.4665* (0.1924)	-0.0382 (0.2393)	-0.1992* (0.0633)	0.9754 ( )
Kenya	-1.9288 (6.9426)	-0.2543* (0.1097)	0.9337 (1.6921)	-0.0233* (0.0083)	-0.2951* (0.0684)	0.0658* (0.0238)	0.1951 (0.1521)	1.6008* (0.4379)	0.7024* (0.1777)	0.9571 ( )
Madagascar	0.1161* (0.0772)	-1.2216* (0.332)	-0.8948* (0.0921)	0.1228* (0.0344)	-0.9902* (0.1248)	0.0628** (0.0337)	-0.2363 (0.1835)	-1.6824* (0.4595)	0.6798** (0.353)	0.8673 ( )
Malawi	0.5339* (0.0676)	-0.3416* (0.0876)	-0.4482* (0.0224)	-0.2901* (0.0144)	-0.3952* (0.1092)	0.1235* (0.0193)	-0.635 (0.0531)	-0.9148* (0.2257)	0.4005* (0.0811)	0.9621 ( )
Mali	5.5923* (0.9112)	0.0107 (0.0132)	-0.6449* (0.2309)	0.0129 (0.0113)	0.0664* (0.0255)	0.0206* (0.01)	0.0269 (0.0405)	0.7424* (0.0914)	-0.2756* (0.0476)	0.8426 ( )
Mauritius	0.0541 (5.0538)	-0.0663** (0.0409)	-0.4854 (1.5034)	0.2134* (0.0774)	-0.9691* (0.009)	0.0415*** (0.0236)	-0.0949 (0.083)	0.1528 (0.1052)	0.822* (0.1139)	0.9573 ( )

**Table A<sub>2</sub> cont**

	Country	lnk	lnL	lnH*lnlnk	lnOpen	lnStot	lnFina	lnPopg	lnInvest	R <sup>2</sup>
Niger	-0.4233*	0.4105*	0.6725*	0.0127	-0.4601	0.0836*	-0.1063**	0.5013*	-0.2234**	0.9362
	(0.0552)	(0.1552)	(0.2309)	(0.0257)	(0.0807)	(0.0216)	0.058()	(0.2382)	(0.1347)	()
Nigeria	2.9124*	-0.064	-0.5008*	-0.3258*	-0.6866*	-0.1083	0.1279*	6.0354*	-0.3772	0.8334
	(0.8665)	(0.0955)	(0.0591)	(0.0451)	(0.1143)	(0.0789)	(0.0418)	(2.6083)	(0.3324)	()
Rwanda	2.3439*	0.0766	-0.0857*	-0.0075	-0.6711*	0.0233	0.0129	-0.0173	-0.0766	0.8002
	(0.4764)	(0.0771)	(0.0088)	(0.0124)	(0.0505)	(0.0389)	(0.0841)	(0.0407)	(0.2378)	()
Senegal	20.0239***	-0.0231	-0.7627	-0.1405*	-0.2543*	0.0076	0.8491*	0.2546	0.2823*	0.9599
	(11.9356)	(0.0238)	(0.7735)	(0.028)	(0.0418)	(0.0129)	(0.1364)	(0.329)	(0.0725)	()
Sierra Leone	1.0797*	-0.0193	-0.3605*	-0.013	-1.2485*	-0.723	0.0221	-5.7865*	3.3724*	0.9749
	(0.0789)	(0.1498)	(0.0853)	(0.0813)	(0.2812)	(0.0773)	0.1151()	(0.78)	(0.4892)	()
Sudan	3.1475*	0.8527*	-0.1077*	-0.3724*	-0.0518	0.3318*	0.3318*	0.5446	0.3206*	0.9857
	(0.3978)	(0.5222)	(0.0064)	(0.0369)	(0.1627)	(0.066)	(0.066)	(0.2184)	(0.1165)	()
Tanzania	0.6216*	0.7954*	-0.9139*	-0.6655*	-0.8578*	0.2625*	0.4349*	-2.2639*	-2.1792*	0.977
	(0.1922)	(0.5257)	(0.546)	(0.0585)	(0.1267)	(0.0514)	(0.0625)	(0.9346)	(0.3717)	()
Togo	-0.3579*	-0.128***	0.032*	-0.1021**	-0.0229	0.0379*	0.1986*	0.3601*	0.331*	0.8953
	(0.0877)	(0.0814)	(0.0051)	(0.0573)	(0.0152)	(0.0116)	(0.0755)	(0.0679)	(0.0821)	()
Uganda	0.0475	1.4952*	1.5161*	-0.3736*	0.5202*	0.067	-0.649*	0.3696***	0.1608	0.987
	(0.5071)	(0.1185)	(0.204)	(0.0633)	(0.1082)	(0.0523)	(0.1025)	(0.2219)	(0.1807)	()
Zimbabwe	4.8455*	0.144*	-0.2065*	0.0529**	0.4751*	0.1567*	-0.1265	2.8*	0.5099*	0.9324
	(0.2878)	(0.0579)	(0.06)	(0.0273)	(0.0885)	(0.0394)	(0.19)	(0.2481)	(0.1402)	()
Zambia	1.6337*	-0.5656*	-0.1309*	-0.9714*	-1.502*	0.0588	-0.1468*	6.5759*	2.3253*	0.9298
	(0.2836)	(0.2041)	(0.0131)	(0.1177)	(0.5513)	(0.1189)	0.0461()	(1.6562)	(0.3843)	()

**Table A<sub>3</sub>: Seemingly unrelated regression (SUR) estimates of production functions: implied output elasticity with respect to labour**

Country	lnL	lnL <sub>h</sub>
Benin	-1.7899	-3.5158
Burkina Faso	-0.8778	0.0475
Cameroon	-1.6719	-3.7886
Central Africa Republic	1.715	1.7876
Chad	-2.1667	0.049
Congo Republic	0.5223	0.2123
DRC	1.1798	0.3877
Gabon	0.06152	0.0705
The Gambia	-0.8288	0.3182
Ghana	-0.4727	0.0271
Ivory Coast	-0.0074	-0.0185
Kenya	1.9129	-2.2169
Madagascar	0.8496	0.3223
Malawi	0.7154	2.1227
Mali	0.5553	0.5014
Mauritius	4.0475	1.4511
Niger	1.5194	0.4048
Nigeria	0.9724	1.5153
Rwanda	0.7171	1.0268
Senegal	0.1665	1.7056
Sierra Leone	0.2361	0.7976
Sudan	-0.6846	0.8579
Tanzania	0.0694	-0.3918
Togo	2.0232	1.5301
Uganda	0.2236	0.2912
Zambia	0.9714	1.1177
Zimbabwe	0.6664	0.8291

**Table A4: Average total factor productivity (TFP) and the ranking of Sub-Saharan Africa (SSA) countries**

Country	TFP	TFP <sub>h</sub>	Rank (TFP)	Rank (TFP <sub>h</sub> )
Fixed-effect estimates using annual data				
Benin	-5.1694	-5.1445	20	20
Burkina Faso	-5.1629	-5.1184	19	19
Cameroon	-4.0284	-4.0692	11	13
Central Africa Republic	-5.1972	-5.1866	21	21
Chad	-2.4123	-1.8566	6	4
Congo Republic	-2.4456	-2.3863	7	7
DRC	0.1992	0.3522	2	2
Gabon	-4.9069	-4.9634	18	18
The Gambia	-4.3467	-4.184	14	14
Ghana	-5.7681	-5.6628	25	25
Ivory Coast	-4.3836	-4.4104	15	15
Kenya	-4.1271	-4.0333	13	12
Madagascar	-5.4805	-5.568	22	24
Malawi	-4.6634	-4.5689	17	16
Mali	-5.8537	-5.8407	26	26
Mauritius	-5.6568	-5.559	24	23
Niger	-3.9958	-3.9665	10	11
Nigeria	-2.0981	-2.0397	4	5
Rwanda	-2.9559	-2.4976	8	8
Senegal	-4.5399	-4.5945	16	17
Sierra Leone	-2.2126	-2.213	5	6
Sudan	0.5082	0.6879	1	1
Tanzania	-4.0444	-3.9728	12	10
Togo	-6.5436	-6.4932	27	27
Uganda	-1.4941	-1.467	3	3
Zambia	-5.545	-5.545	23	22
Zimbabwe	-2.9901	-2.9901	9	9
Fixed-effect estimates using data in 3-year averages				
Benin	-4.2441	-4.4141	12	14
Burkina Faso	-4.3243	-4.4938	17	17
Cameroon	-4.1983	-4.3907	10	13
Central Africa Republic	-4.3977	-4.5896	21	22
Chad	-4.9481	-4.9085	26	26
Congo Republic	-5.0302	-5.1525	27	27
DRC	-4.1744	-4.2449	8	6
Gabon	-4.5399	-4.7366	25	25
The Gambia	-4.264	-4.3788	14	12
Ghana	-4.4018	-4.5425	22	20
Ivory Coast	-3.9567	-4.1449	1	1
Kenya	-4.293	-4.4283	15	15
Madagascar	-4.4318	-4.6566	23	23
Malawi	-4.3919	-4.5293	18	18
Mali	-4.5056	-4.6933	24	24
Mauritius	-4.2995	-4.4936	16	16
Niger	-4.212	-4.3678	11	11

Nigeria	-4.0702	-4.206	4	3
Rwanda	-4.2509	-4.2456	13	5
Senegal	-4.093	-4.3039	5	10
Sierra Leone	-4.0439	-4.2226	3	4
Sudan	-4.1704	-4.2591	7	7
Tanzania	-4.1156	-4.2761	6	8
Togo	-4.3958	-4.558	20	21
Uganda	-4.0185	-4.1786	2	2
Zambia	-4.3461	-4.5347	18	19
Zimbabwe	-4.1747	-4.2943	9	9

SUR estimates

Benin	14.6179	20.7232	2	1
Burkina Faso	9.0083	5.9274	4	10
Cameroon	10.1636	18.1131	3	2
Central Africa Republic	-10.4392	-10.593	24	27
Chad	15.5568	7.7196	1	7
Congo Republic	7.0038	12.6802	7	4
DRC	-20.0383	-7.9562	27	25
Gabon	3.7312	3.0487	9	13
The Gambia	8.9533	13.8435	5	3
Ghana	1.3286	6.1993	13	8
Ivory Coast	-2.0379	-1.5984	19	19
Kenya	8.0875	10.3506	6	6
Madagascar	-1.2918	11.5306	17	5
Malawi	-1.9041	-6.877	18	24
Mali	1.4269	1.001	12	17
Mauritius	-11.0453	-4.6767	25	22
Niger	-5.6386	-1.083	22	18
Nigeria	2.863	1.4858	10	15
Rwanda	0.5792	2.3542	14	14
Senegal	-3.2433	-0.3011	20	16
Sierra Leone	-0.973	-8.1094	15	26
Sudan	-1.2421	3.7652	16	12
Tanzania	6.7515	5.9873	8	9
Togo	-7.0554	-5.1995	23	23
Uganda	2.0929	4.779	11	11
Zambia	-18.8344	-3.4762	26	21
Zimbabwe	-3.8024	-2.2712	21	20



**Table A<sub>5</sub>: List of the different subgroups of Sub-Saharan Africa (SSA) countries**

CFA countries	Central Africa CFA countries	West Africa CFA countries	Low-income countries	Middle-income countries	Oil-producing countries	Conflict countries	Landlocked countries
Benin	Cameroon	Benin	Benin	Gabon	Cameroon	CAR	Burkina Faso
Burkina Faso	CAR	Burkina Faso	Burkina Faso	Mauritius	Congo Republic	Congo Republic	CAR
Cameroon	CAR	Ivory Coast	Cameroon		Gabon	DRC	Chad
CAR	Congo Republic	Mali	CAR		Nigeria	Ivory Coast	Mali
Chad	Gabon	Niger	Chad			Sierra Leone	Niger
Congo Republic		Senegal	Congo Rep.			Sudan	Rwanda
Gabon		Togo	DRC (Zaire)				Zambia
Ivory Coast			Gambia, The				Zimbabwe
Mali			Ghana				
Niger			Ivory Coast				
Senegal			Kenya				
Togo			Madagascar				
			Malawi				
			Mali				
			Niger				
			Nigeria				
			Rwanda				
			Senegal				
			Sierra Leone				
			Tanzania				
			Togo				
			Uganda				
			Zambia				
			Zimbabwe				

**Table A<sub>6</sub>: Total factor productivity (TFP) growth (%) by country in Sub-Saharan Africa, 1965-2000**

Country	1965-2000		1991-1995		1996-2000	
TFP estimates using annual data						
	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>
Sub-Saharan Africa	5.5673	-0.4741	11.3862	11.4081	6.1692	9.2787
Benin	2.0381	2.2108	-1.0178	-0.9659	2.7655	2.9729
Burkina Faso	2.2751	2.5135	1.854	1.7243	1.4643	1.4759
Cameroon	2.436	2.4363	-2.2094	-2.0447	1.7859	1.7875
CAR	1.0709	1.2063	3.0836	3.07	0.6682	0.8628
Chad	-10.6185	-6.653	2.5372	3.36	5.2922	5.1458
Congo Republic	2.5438	18.4982	-89.7691	-92.6874	10.7577	18.2446
DRC	-6.7851	-4.5313	20.6036	21.5945	3.2236	3.3431
Gabon	0.4135	0.5511	-2.3558	-1.8567	3.0934	3.3104
The Gambia	0.3339	0.3753	1.1091	1.3625	-5.7514	-5.8224
Ghana	4.2988	4.3982	3.0928	3.0058	2.6536	2.6493
Ivory Coast	1.6043	2.0132	9.796	10.3614	0.8398	0.9514
Kenya	11.548	10.8937	3.7594	3.8907	1.1534	1.2927
Madagascar	1.0954	1.0804	1.4912	1.4078	1.7823	1.6842
Malawi	2.0676	2.1796	1.7132	1.5804	3.5648	3.8897
Mali	-0.2422	-0.1374	1.3675	1.4437	0.9948	1.0059
Mauritius	1.9053	1.8185	0.9441	0.8729	0.5448	0.6779
Niger	3.4412	3.8544	-1.6472	-1.539	-1.0287	-0.8344
Nigeria	10.3927	-8.8042	21.5865	27.1273	9.7677	10.267
Rwanda	2.0147	4.2137	8.4746	11.7956	2.3286	2.983
Senegal	2.0171	2.0505	1.5855	1.6506	1.8662	1.9259
Sierra Leone	-2.3327	0.968	2.0742	1.86	7.5522	7.8808
Sudan	7.0701	-9.3074	23.4781	25.4808	1.7333	1.8662
Tanzania	2.2122	2.507	2.767	2.973	-1.74	-1.6542
Togo	1.139	1.1456	-1.0761	-1.0628	0.4499	0.5058
Uganda	19.69	20.3427	82.6028	81.7125	6.8797	7.1508
Zambia	5.3703	5.3576	7.6636	7.7092	4.9839	5.0066
Zimbabwe	4.9673	5.2182	6.9173	7.1487	7.9433	8.1726



**Table A<sub>6</sub> cont...**

	TFP estimates using data in 3-year averages					
	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>
Sub-Saharan Africa	1.6633	1.7416	7.9808	7.9927	-1.6832	-1.5967
Benin	0.006	0.2036	-0.3268	-0.0953	0.3177	0.4515
Burkina Faso	0.2859	0.5169	1.1318	1.0929	-0.0768	-0.118
Cameroon	-0.1021	-0.0722	-0.6114	-0.8447	-0.1195	-0.1237
CAR	-1.5977	-1.3251	-0.3121	-0.3603	-0.0561	0.369
Chad	-0.2252	0.5084	2.7625	3.0534	-0.3529	-0.1114
Congo Republic	11.3797	10.6737	39.5022	37.2772	18.4957	17.8645
DRC	13.4233	13.1808	75.9415	75.1686	9.9511	9.2959
Gabon	0.1896	0.1336	8.873	8.4468	-10.3667	-9.6648
The Gambia	-0.0047	0.0224	0.9117	1.1118	-2.0721	-1.87
Ghana	-2.2799	-2.267	2.9032	2.5397	-21.3463	-20.8592
Ivory Coast	-0.2702	-0.0445	-0.9113	-0.4537	0.192	0.396
Kenya	2.4231	2.366	2.295	2.4059	8.5262	8.397
Madagascar	1.97	1.8204	26.7905	25.2533	-17.1134	-16.6247
Malawi	1.024	1.0524	1.9488	1.7403	1.067	1.4962
Mali	1.1263	1.1777	0.8271	0.9114	7.9585	7.3899
Mauritius	5.3818	5.135	0.8453	0.3636	-1.2792	-0.9556
Niger	-0.2113	0.1315	-0.3551	-0.4393	-0.5379	-0.3798
Nigeria	5.8489	5.8077	3.6723	3.6362	-1.2162	-0.5317
Rwanda	0.4505	0.9963	1.2961	7.0611	1.1103	-2.6764
Senegal	0.1989	0.2486	0.8753	0.8766	0.0087	0.0026
Sierra Leone	-2.5577	-2.4206	0.3821	0.298	-24.0972	-22.9448
Sudan	2.234	2.348	6.5128	6.7151	-3.1599	-3.0634
Tanzania	0.9617	1.2616	-4.6356	-3.8115	-3.9143	-3.2688
Togo	-0.2187	-0.1256	-0.096	-0.116	-0.2552	-0.1303
Uganda	4.1196	4.0226	36.5304	35.0814	-0.5912	-0.0812
Zambia	-0.0023	0.1823	2.4452	6.2789	-11.6783	-10.6633
Zimbabwe	1.3551	1.4882	6.2832	2.6122	5.1608	5.2903

**Table A<sub>6</sub> cont...**

	TFP using SUR estimates					
	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>	TFP	TFP <sub>h</sub>
Sub-Saharan Africa	-6.2867	23.4136	-1.954	-52.5453	4.1361	2.6349
Benin	0.0486	0.0606	0.2509	0.2291	0.2296	0.093
Burkina Faso	0.0381	0.2784	-0.0332	-0.1495	0.2397	0.6346
Cameroon	0.0123	0.0077	0.0575	-0.061	-0.0189	0.1145
CAR	0.2308	0.2475	-0.024	0.0217	-0.8713	-0.715
Chad	0.0599	-0.526	-0.3837	-0.6153	0.4493	0.1779
Congo Republic	0.0717	0.6291	-1.6819	3.4467	-5.282	-1.5332
DRC	1.883	3.1145	2.9604	5.7928	0.2384	2.1192
Gabon	0.8538	2.0499	6.699	10.1187	-0.3764	-1.8948
The Gambia	0.3373	4.4143	-3.6683	1.0937	4.6628	4.9754
Ghana	-8.1057	-1.2893	-7.5124	-8.3144	32.989	2.5151
Ivory Coast	-11.8689	-9.2998	1.3238	0.4101	-0.9721	-0.0623
Kenya	0.1574	0.1026	1.0806	3.5475	0.2896	-0.6105
Madagascar	5.9166	0.2808	4.9143	0.6488	6.5875	0.2767
Malawi	3.824	0.0818	18.1422	1.4665	9.3059	3.1406
Mali	0.5136	-0.584	-2.7765	-2.8221	0.6509	3.625
Mauritius	-0.0228	0.1855	0.0062	0.3548	0.0744	-0.124
Niger	0.3333	5.8107	0.6338	-0.0694	0.28	-0.0565
Nigeria	5.8226	-7.0329	-21.0363	-23.4797	25.9165	28.6949
Rwanda	-9.881	-20.4265	-75.3256	-13.695	27.606	0.9497
Senegal	0.1144	-0.2886	-0.4276	-0.7402	0.6546	0.6624
Sierra Leone	-78.2322	0.6273	4.4646	-2.5084	7.8841	1.5785
Sudan	-11.338	-2.5863	24.2309	-49.6772	8.4454	38.3723
Tanzania	0.1856	-1.7016	-1.0783	-2.3922	-2.293	-7.8231
Togo	0.1394	0.1191	0.542	0.7473	-0.2303	-0.264
Uganda	1.2045	-45.7887	-6.0717	9.1837	-4.8664	0.8332
Zambia	-0.0812	-32.8915	0.8083	8.4456	-2.4774	-6.6986
Zimbabwe	0.9928	17.9412	1.4482	5.2953	2.5594	2.1564





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